Enhancing Agriculture in Africa: A U.S. Role in Development Assistance

Volume II--Contract Papers

Part A: Principles of Low-Resource Agriculture

1. Low-Resource Agriculture in Sub-Saharan Africa: Principles and Concepts for Managing Natural Resources
   (*C. Gregory Knight and R. Dennis Child*)
2. Low-Resource Agriculture in Sub-Saharan Africa: Principles and Concepts for Managing Inland Fisheries
   (*John H. Grover and Stephen P. Malvestuto*)
3. Principles and Concepts of Productive Human Resource Systems
   (*Anne Fleuret*)
4. Principles and Concepts of Effective Institutions
   (*Milton Esman*)
5. Incorporating Participatory Approaches in Institutions
   (*Paula Donnelly-Roak, and Grace Hemmings-Gaphihan*)
6. Low-Resource Agriculture and African Institutional Development
   (*Elinor Ostrom*)

December 1987

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Contract Paper No. 1

DRAFT

LOW-RESOURCE AGRICULTURE IN SUB-SAHARAN AFRICA: PRINCIPLES AND CONCEPTS FOR MANAGING NATURAL RESOURCES

by

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May 1986

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Low-Resource Agriculture in Developing Countries: Implications for Africa
WORK STATEMENT

Title: Low-Resource Agriculture in Sub-Saharan Africa:
Principles and Concepts for Managing Natural Resources

I. Background Information

OTA is commissioning information from four authors on the principles and concepts for 1) natural resource management (Dennis Child and Gregory Knight), 2) effective institutions (Milton Esman), and 3) productive human resource systems (Anne Fleuret). We have chosen these areas in order to emphasize each in a manageable way. We recognize that the distinction between human and institutional resources can be unclear. As OTA uses these terms, "human resource system" means social units such as households, groups, villages and communities with which low-resource agriculturalists have direct contact. The "institutional resource system" means the formal organizations, such as government agencies, private voluntary groups, etc., which serve functions such as research, training, and extension and which deal with broader economic, social and political environments.

Each author's written material should focus primarily on the one assigned resource system. OTA will conduct a workshop for the authors and other participants to discuss how management of the three types of resource systems can be integrated.

A. Definitions and Characterizations

The author will use these definitions and characterizations:

1) Low-Resource Agriculture: Agricultural systems used by poor, small-scale farmers and herders that rely principally on local inputs in order to support household activities. While these systems are diverse, they generally share certain important characteristics, such as being:

- low-risk rather than high-yield
- low-cost
- dependent upon local knowledge
- dependent upon biological processes and renewable resources
- adapted to local environments and cultures
- dynamic and experimental within constraints imposed by risks
- diversified

2) Low-Resource Agriculturalists: A heterogeneous group of rural people who generally are poor and who have limited access to and control over land, water, labor, capital, external sources of information and technology, and external inputs such as commercial fertilizer.

B. Assumptions

The author will undertake this work with the following assumptions or will consult with OTA before using others.

1) Many people consider low-resource agriculture as the problem that prevents increasing food production in Africa. Instead we consider it both a problem, since low-resource agriculturalists are poor, and a solution, since solutions must match existing conditions. Therefore we will build upon existing opportunities instead of focusing only on removing constraints.

2) Crop and livestock production is a major activity of low-resource agriculturalists but they may also engage in cash crop production, fish-farming, forestry, and food processing and marketing. While the focus of this study is on Africa, we expect to examine technologies and policies in a broader context of the developing world and United States' agricultural interests.

C. Goals of Development

The author will accept that low-resource agriculturalists in Africa should themselves determine their development goals and that their strategies will be varied. Effective and appropriate U.S. goals to assist them are:

1) to increase people's quality of life, e.g., reduce drudgery, expand choices, increase income and employment, and improve health and nutrition.
2) to reduce vulnerability.
3) to maintain, build upon, and improve indigenous resources and systems.
4) to ensure economic and environmental sustainability.
5) to improve the quantity and quality of agricultural production.
6) to remove or reduce production, marketing, storage, and processing bottlenecks.

II. Specific Responsibilities of the Author

A. The author will take part in a one-day meeting at OTA on March 19, 1986 to discuss, with several other contractors and OTA staff, the contents of this work.

B. The author will prepare and deliver written material acceptable to OTA by May 1, 1986. This material will not exceed the maximum allowable lengths provided by OTA for each section. Material that does not reach OTA or the author's co-author (Gregory Knight) by the deadlines set out below or that exceeds these limits is not acceptable to OTA and does not fulfill this contract. This material will include:

1) a brief, 1-2 page list of principles and concepts that apply to natural resource management in low-resource agriculture in sub-Saharan Africa. This list should summarize and accompany a 5-page commentary describing the principles and concepts. In the commentary, the author/s should note other experts' ideas and identify key literature on the subject but this section is not meant to be exhaustive. The co-authors will integrate their work into one submission to OTA.

2) a discussion of how these principles and concepts have been and can be applied to development in sub-Saharan Africa. This discussion should emphasize practices (see suggested contents), e.g., maximizing spatial heterogeneity of crop roots to make full use of available water and:

   a. include the technical aspects of application, e.g. intercropping

   b. include the institutional aspects of application, e.g., expanding intercropping research at national and international agricultural research centers.

   c. identify constraints to application, e.g., overcoming bias of Western-trained scientists towards "traditional" agricultural practices.

   d. consider how ecological and social diversity might affect applications, e.g., examine how applications might differ in arid vs. humid regions, or in pastoral vs. sedentary societies.

   Illustrate these applications with examples, not necessarily from Africa. The co-authors will integrate their work and provide OTA with one 30-40 page discussion.

Dennis Child will prepare a first draft of items 1) and 2) and deliver them to Gregory Knight and OTA by March 31, 1986. Gregory Knight will deliver revisions of these materials to Dennis Child and OTA by April 25, 1986. Dennis Child will deliver the final draft of items 1) and 2) to OTA by May 1, 1986.

3) **an appendix of 6-10 brief (1-2 page each) African case studies illustrating the applications discussed above. Are these examples replicable? Why and how have they worked or not worked? Each co-author will provide 3-5 separate case studies; the co-authors will be responsible for ensuring that some case studies discuss mixed crop/livestock farming systems.**

4) a brief discussion (5 pages for each question) of:

   - o How would application of the author's principles and concepts for managing natural resources affect the six goals of development set out above? What conflicts arise; what trade-offs are necessary?

   - o How could different development assistance organizations, e.g., AID, PVO's, effectively apply the author's principles and concepts for managing natural resources? What impediments exist?

The author will prepare items 3) and 4) separately and deliver them to OTA by May 1, 1986.

C. The author will take part in a 2-day workshop at OTA during June, 1986, to integrate the author's materials with that of the two companion papers. This meeting will produce Congressional options for encouraging such integration, e.g., by passing new legislation, changing appropriations, carrying out oversight, etc.

OTA will circulate each author's contributions to the other authors during May, 1986 and:

- o each co-author will address briefly (no more than 5 pages) how the principles and concepts for managing natural resource systems can be integrated with those for effective institutions and productive human systems in order to achieve our development goals. This material will be submitted to OTA by June 1, 1986.

D. The author's work will be reviewed by the assessment's Advisory Panel and other peers and the author will respond to comments and revise material as needed. This review will take place prior to the June meeting of the working group, with revisions due one month after the meeting or August 15, whichever comes first.

- o The author will provide, with other written material submitted by May 1, 1986, the names and affiliations of three potential reviewers.

E. The author will provide OTA with oral progress reports bi-weekly.

III. Format for Written Materials

A. All written materials will be submitted typed double-spaced on 8 1/2 by 11 inch papers, with paragraphs numbered if possible.

B. If possible, these materials also will be submitted via IBM-compatible disk or via modem to OTA's IBM or NBI system using an ASCII code.

C. A complete list of literature cited will be included, following the examples attached.

D. Literature referenced within the text will be cited as (Author, year).

E. Information attributed to personal communications will be cited as (Name, pers. comm., date). These names will be included in the list of literature cited, with the communicant's affiliation, and address.

F. The use of footnotes is optional but, if used, they should be submitted separately at the end of the relevant material.

G. If acronyms and technical language are used, they will be defined in the text and a list of acronyms and glossary included.

H. Photographs, slides, or other types of illustrations will be included with the delivered material if available. A numbered list of these will be included with the written material.

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of natural resource management

A. Increase productivity: measure of output per unit of resource; eg, yield, income

B. Improve quality: defined by its benefits to the humans in the system (nutritional, medicinal, etc)

C. Ensure sustainability: ability of system to allow continued or improved productivity

D. Ensure stability: ability of system to maintain productivity in spite of disturbance (eg, varying rainfall, fluctuations in market prices). Most conveniently measured by the reciprocal of the coefficient of variation in yield or income

E. "Close" the system as much as possible: reduce the loss of resources other than through harvesting

F. Rely on biological processes as much as possible

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices for managing energy use, water use, land use, pest control, and maintenance of genetic diversity . For example:

I. Low-resource agriculture in sub-Saharan Africa: Management practices (including some examples --- with more detailed examples to be appended as case studies)

A. Practices for managing water use:

1. maintain vegetative and/or litter cover to reduce runoff and evaporation

2. maintain soil organic matter to increase infiltration, allowing the soil to act as a sponge absorbing and holding water

3. maximize spatial heterogeneity of roots to minimize leaching

4. use plants and animals adapted to local water regieme

5. use water harvesting and irrigation techniques that use water renewably rather than mining it; e.g.,
    a. diguettes in Burkina Faso (increase infiltration and reduce runoff, thereby increasing productivity and "closing" the system)
    b. etc

Companion Paper on Productive Human Resource Systems

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of productive human resource systems

- A. Ensure access to, control over, and mobilization of local productive resources
- B. Minimize risk
- C. Blend cultural continuity with change
- D. Match the multiple goals and functions of groups to the actual needs, perceptions, and priorities of individuals
- E. Ensure a functional internal division of labor
- F. Ensure equity through participation in decisions, actions, and benefits affecting individuals and groups (focusing on who and how rather than just numbers in all stages of planning, implementation, evaluation, and benefit sharing of projects and programs)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use by human systems of the resources (i.e., land, water, labor, and capital) they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use of resources of human resource systems (including some examples -- with more detailed examples to be appended as case studies)

- A. Labor:
  - 1. mobilize underutilized and unutilized labor and skills, e.g.
    - a. food for work
    - b. etc.
  - 2. maximize local employment opportunities
    - a. provide local opportunity for small scale service industries
    - b. provide training and local materials to capitalize on opportunities
  - 3. maximize productive potential of all members of agricultural labor force
    - a. reduce drudgery
    - b. value unpaid work of members
  - 4. improve skills through training
    - a. demonstration farms, etc.

Companion Paper on Effective Institutions

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of effective institutions

   A. Ensure wise use and development of human resources (e.g., technical skills, attitudes, numbers of people) to serve low-resource agriculturalists

   B. Ensure wise use and development of capital and other assets (e.g., money, infrastructure, inputs, knowledge, policies, procedures) to serve low-resource agriculturalists

   C. Develop ability and accountability to sustain development process for low-resource agriculturalists

   D. Develop capability for flexibility: adaptability to cultural context; capacity for institutional learning; development of a diversity of strategies to deal with diversity of needs

   E. Use criteria for selection, development, and diffusion of technologies that consider technical efficiency, advantages accruing to the household (e.g., income, reduced drudgery, status) and advantages accruing to society (e.g., income distribution, employment, resource conservation, foreign exchange)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use of and development by institutions of the resources (e.g., labor and capital) that they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use and development of institutional resources (including some examples -- with more detailed examples to be appended as case studies)

   A. Capital and other assets (e.g., procedures)

      1. ensure local participation (i.e.,)
         a. planners must go out to field
         b. extension workers must link farmers and researchers

      2. provide timely delivery of money, information, inputs, services, etc.

      3. must allow for problem-solving and not prescriptions
         a. must address diverse needs of diverse groups
         b. planning should be iterative process incorporating feedback
         c. must use and develop management skills (e.g.,administrative, priority setting, research management, etc.)

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Food & Renewable Resources Program

EXAMPLES FOR REFERENCE STYLE
(alphabetized by author's last name)

Clark, C.O. "Saline-Seep Development on Nonirrigated Cropland," pp. 22-33 Proceedings Saline Seep-Fallow Workshop. Highwood, MT: Highwood Alkali Control Association, 1971.	(Paper in conference proceedings)
David, W.H. (ed.). Desertification of the United States. Washington, DC: Council on Environmental Quality, 1971, 142 pp.	(Edited Book)
Donstreich, M.D., Leopold, A.C., and Ardrey, R. "Food Habits of Early Man: Balance Between Hunting and Gathering." Science 179:306-307, 1973.	(Multiple Authors journal article)
Frederick, K.D. "Irrigation and the Future of American Agriculture," The Future of American Agriculture as a Strategic Resource, S.S. Batie and R.G. Healy (eds.) pp. 157-190. Washington, DC: The Conservation Foundation, 1980.	(Article in edited book)
Pirie, N.W. "Orthodox and Unorthodox Methods of Meeting World Food Needs." Scientific American 216(2):27-35, 1967.	(One-author journal article)
Robertson, L.S. Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI. Personal communication, Aug. 5, 1981.	(Personal communication)
Sheridan, D. Desertification of the United States. Washington, DC: Council on Environmental Quality, 1981, 242 pp.	(Book)
Shih, S.F., et al. "Subsidence Related to Lane Use in Everglades Agricultural Area." Transactions of the American Society of Agriculture Engineers 22(3):560-563, 1979.	(More-than-3-author article)
"Two Firms Fined $4,000 Each for PBB Contamination of Cattle Feed in Michigan." Toxic Material News p. 144, May 1978.	(No author named)
Voorhees, W.B. "Soil Compaction, How It Influences Moisture, Temperature, Yield, Root Growth." Crops and Soils Magazine 29(6):14-15, 1977a.	(Same author, same year or different year, alphabetize by title)

Voorhees, W.B. "Soil Compaction, Our Newest Natural Resources." *Crops and Soils Magazine* 29(5):26-27, 1977b.	(Same author, same year or different year, alphabetize by title)
U.S. Congress, Senate Select Committee on Nutrition and Human Needs. *Dietary Goals for the United States*. Washington, DC: U.S. Government Printing Office, 1977.	(U.S. Congress)
U.S. Department of Agriculture, ESCS. "A Process of Identifying Emerging Social and Economic Issues and Implied Research Needs." Unpublished draft report, Washington, DC, October 1979.	(Unpublished draft)

Draft

PRINCIPLES AND CONCEPTS

1. Treat agricultural practices as integrated systems rather than isolated enterprises.

2. Introduce or support technological change with recognition of uniqueness of production units within a great diversity of system types.

3. Energy flows through the ecosystem -

   a. Channel photosynthetic activity for human use.
   b. Maximize productive use of solar radiation.

4. Management strategies must be sustainable and have minimum risk to the producer.

   a. Maintain economic, ecologic and genetic diversity while providing an optimal mix of goods and services.
   b. Maintain cultural, technological, and genetic continuity.
   c. Ensure stability.
   d. Select new technologies that do not increase vulnerability to failure under sub-optimal conditions.
   e. Enhance diversity as a major African agricultural strategy to maximize productivity and minimize risk or uncertainty.
   f. Minimize irreversible and irretrievable resource commitments; maximize future choice in resource allocation (UNEP, 1980; Brown and Wolf, 1985):
   g. Minimize the potential for normal ecological variation and cyclicity being converted to seculaar environmental change by human action.
   h. Meet needs for protective resource preservation and conservation. Recognize and allocate needs for protective resource use, such as forests, watersheds, wildlife populations, and vulnerable land (Poore, 1976, p. 12).

5. Work within seasonal, structural and spatial constraints

   a. Synchronize spatial and temporal structure in relation to seasonal fluxes of flow resources.
   b. Organize space.
   c. Overcome the challenge of production concentrated in time and dispersed over space with consumption needs concentrated in space and continuous through time.

6. Change and climatic fluctuation is to be expected in natural resource systems -

   a. Recognize the seasonal and progressive dynamics of agricultural systems, and utilize on-going processes of productivity increase.
   b. Farming systems are by nature dynamic through given seasons and through successive years, due to such factors as seasonal fluctuations of environmental factors and progressive or secular changes in population density, orientation to cash crops, availability of land resources, and similar factors (Knight, 1974; Kowal and Kassam, 1978; Okigbo and Greenland, 1976; Harwood, 1982; Ruthenberg, 1980).
   c. Utilize the annual agro-climatic calendar as an integrating concept for maximizing productivity.
   d. Maximize productivity by articulation of agricultural activities in relation to the annual climatic calendar. Farming systems exhibit seasonal cycles of behavior involving fluxes of energy, water, and human activity in response to the annual climatic calendar (Hawksworth, 1984; ICRISAT, 1980; Lal and Russell, 1981; FAO, 1978; Cusack, 1983; Porter, 1979).

7. Utilize renewable and non-renewable resources effectively.

   a. Maximize productivity from and minimize dependence upon non-renewable resources (Leach, 1976; Pimentel, 1980; Bayliss-Smith, 1982):
   b. Maximize system closure to the flow of renewable and non-renewable resources.
   c. Utilize renewable resources for sustained productivity. Effectively utilize and recycle renewable resources such as soils, soil nutrients, and plant productivity with a goal of achieving sustained productivity.

8. Control processes of plant and animal succession.

   a. Control succession from desired to undesirable plant and animal communities that would divert environmental resources, using weeding, trapping, guarding, fencing and similar strategies.
   b. Provide crop and livestock protection.

9. Use local knowledge and indigenous plant and animal species where possible -

   a. Exploit opportunities based on local knowledge and resources prior to introduction of exogenous technologies (UNEP, 1980; Klee, 1980; Richards, 1983; 1985; Brokensha, Warren and Werner, 1980; Farvar and Milton, 1972).

b. Human societies are central in the development, selection and maintenance of the informational, technological, and genetic information that drives agricultural systems (Knight, 1976; Kowal and Kassam, 1978).
c. Rely on local biological and physical processes as much as possible versus dependency on exogenous inputs that may introduce uncontrollable sources of vulnerability (Altieri, 1983).
d. Maintain and develop existing resource investments rather than abandon extant efforts for new projects with new commitments of land and other ecological resources (Eicher, 1986, p. 4).

10. Increase productivity

a. Focus development efforts on food crops that are wanted and best suited for the each region.
b. Increase productivity to the total land area in the agricultural system.
c. Maintain food-production enterprises even when development is focused on non-food agriculture or non-farm activities.
d. Maintain enterprises producing subsistence food supplies to the producing unit (even though additional farm and non-farm activities are developed).
e. Concentrate development in areas of highest agricultural potential:
f. Encourage use of animal-based food sources not dependent on inputs competing with direct human food consumption.
g. Utilize animal sources of protein, calories, and fat only when animals mobilize resources not directly usable by human populations; minimize use of animal food sources dependent upon potential human foodstuffs until the basic caloric, protein, and fat needs of the population are met:
h. Develop integrated crop and livestock farming systems that will synergistically enhance both crop and livestock enterprises.

11. Provide suitable soil physical and chemical conditions for improved plant productivity.

a. Enhance nutrient availability through management of soil reaction (pH).
b. Use deeply rooted crops and(or) fallow plants to recycle nutrients leached beyond normal arable crop root depth.
c. Provide plant nutrients for yield maximization (e.g., Okigbo, 1980).
d. Maintain soil structure for plant root growth and moisture movement (Lal and Greenland, 1979).
e. Recognize the role of microconsumers and decomposers play in the nutrient cycle.

12. Improve productivity to the factor or interacting group of factors that are most limiting.

13. Water management Next to people, water is the most important component in natural resource management. Mitigate potentially detrimental aspects of tropical rainfall regimes.

    a. Use agricultural practices that protect the soil against compaction and surficial erosion related to high tropical rainfall intensities.
    b. Maximize temporary storage of water in the soil to maximize soil water availability, particularly in climatically marginal areas.
    c. Use cropping systems to mitigate the leaching of nutrients.
    d. Prevent excessive waterlogging during the season of greatest rainfall.
    e. On sloped areas with clay subsoils, prevent excess moisture infiltration.
    f. Maintain traditional low-erosion-risk land preparation methods versus continuous mechanized cultivation of seasonal row crops (Lal, 1982).

14. Provide long term monitoring

15. Involve local people throughout the development process -

COMMENTARY ON PRINCIPLES AND CONCEPTS

1. **Treat agricultural practices as integrated systems rather than isolated enterprises.** Agricultural systems organize resources in a way that enterprises (activity subsystems) are linked or related in space (land use), time (agricultural calendar), and use of human resources. Thus, both existing and proposed systems must be seen in totality rather than as isolated enterprises (Dalton, 1975; Harwood, 1982; Hart, 1982; Child et al., 1984; Kowal and Kassam, pp 318-347, 1978; Morgan, 1969; Lowrance, Stinner, and House, 1984; Shaner, Philipp, and Schmehl, 1982a; 1982b).

2. **Introduce or support technological change with recognition of uniqueness of production units within a great diversity of system types.** Contempory agricultural systems have evolved over a long period of adaptation and adjustment to local environmental circumstances (Kowal and Kassam, 1978; Okigbo, 1974). Although these systems can be classified and generalized, each production unit is unique in terms of available resources and management skills. Technological change must recognize the potential diversity of recipients.

   Traditional African agricultural systems are adapted to the local environment. Moreover, they are organized to maximize returns to labor more than other inputs. Nevertheless, they have significant potential for improved productivity (Kowal and Kassam, 1978; De Wilde, 1967; Bunting, 1972).

   In general, applications of modern technology are most evident in market crop enterprises.

3. **Energy flows through the ecosystem** - Plants are the primary producers in the ecosystem, converting the energy of the sun into energy usable by man and animals through the process of photosynthesis. Since energy is lost at each step in the food chain (tropic level) it is more efficient, in terms of energy use, for man to eat only plant products. However, since man cannot digest cellulose efficiently he has learned to use ruminant animals to harvest cellulose and convert it to useable proteins and charbohydrates. When animals are using forage that cannot be directly consumed by humans, the efficiency of the production system is inhanced.

   a. Channel photosynthetic activity for human use.

      - Direct human consumption of plant products
      - Use animal populations to collect, concentrate, detoxify, and(or) convert resources for human use through meat, blood, eggs, or milk (Spedding, 1975)

b. Maximize productive use of solar radiation.

- Ameliorate the negative relationship between solar radiation for photosynthetic activity versus adequacy and reliability of rainfall in Africa (Kowal and Kassam, 1978; Chang, 1968).

    Use water management techniques to decrease risk of precipitation uncertainty.

    Use crop tolerant of rainfall shortfall or breaks in the rains.

- Carefully assess the risks involved in using farming systems dependent on early planting or soil moisture storage to meet evapotranspiration needs after the rainy season.

    Solar radiation is attenuated by the cloudiness of the rainy season; thus potential evapotranspiration is often lower during the rainy season than the beginning and end of the rains. Variability of rainfall at the change of season, combined with the high levels of potential evapotranspiration, poses significant risk to early planting. Early planting, however, allows utilization of initial nitrogen flushes in the soil, before the nitrogen is leached or extracted by weeds.

4. Management strategies must be sustainable and have minimum risk to the producer. This concept has been aptly expressed as "leaving choices for the next generations." Said in another way, natural resource management strategies must not preclude future generations from making similiar dicisions because the natural resource base is no longer capable of supporting that alternative.

a. Maintain economic, ecologic and genetic diversity while providing an optimal mix of goods and services.

b. Maintain cultural, technological, and genetic continuity.

- Human cultural knowledge
- Indigenous technologies and implements
- Seed and vegetative stocks
- Livestock populations

c. Ensure stability.

- Provide for stability by buffering sources of environmental disturbance
- Maximize the minimum conceivable yield from the system
- Ideally, agricultural systems are adapted to producing adequate food supplies in relatively poorer crop seasons. Thus the system should produce a food surplus in normal years, termed the "normal surplus" by William Allan (Allan, 1965).
- Design for yield stability over time

d. Select new technologies that do not increase vulnerability to failure under sub-optimal conditions. New technologies that offer higher return in average or better circumstances during the crop year, but threaten greater vulnerability during poorer years, may not be attractive for adoption. Thus proposed technologies should be tested against worse-than-average conditions and should be compared with existing strategies across the statisticall distribution of probable environmental conditions.

e. Enhance diversity as a major African agricultural strategy to maximize productivity and minimize risk or uncertainty. Use diversity as a major strategy to maximize returns to resource use and to minimize risk and uncertainty.

- Use various kinds of diversity, including diversity of enterprises, of spatial allocation of activity, and of temporal scheduling of activity.

- Use various crop species and varieties, as well as crop enterprises, in the farming system. A diversity of crops provides a buffer against environmental uncertainty. It also offers the advantages of a number of field systems, and it may provide the opportunity to spread labor demands over a wider period of time, decreasing labor underemployment.

- Use spatial dispersion of agricultural enterprises to increase the availability of strategies to utilize varied ecological zones and to spread risks of failure. Such dispersion, however, exacts a labor cost in travel (daily or seasonally) and may introduce other forms of risk, if dispersed enterprises cannot be monitored frequently or guarded continuously.

- Utilize the multiple ecological zones typically found across a catenary succession of soils (soil associations related to common patterns of hill top, valley slope, and valley bottom locations).

- Use hydromorphic areas for dry-season as well as enhanced wet-season production.

f. Minimize irreversible and irretrievable resource commitments; maximize future choice in resource allocation (UNEP, 1980; Brown and Wolf, 1985):

- Minimize irreversible and irretrievable commitments of resources.

- Maximize opportunities for future choice in allocation of resources that have the widest possible use (Poore, 1976, p. 9).

- Minimize negative environmental impacts of development, including water and air pollution and soil erosion (World Bank, 1974; Farvar and Milton, 1972).

g. Minimize the potential for normal ecological variation and cyclicity being converted to seculaar environmental change by human action.

- Mitigate the risks of desertification at the arid margins of arable agriculture and of pastoral activity.

- Prevent normal variation from becoming secular ecological change.

h. Meet needs for protective resource preservation and conservation. Recognize and allocate needs for protective resource use, such as forests, watersheds, wildlife populations, and vulnerable land (Poore, 1976, p. 12).

- Protect "suitably large examples of natural ecosystems and of populations of plant and animal species" (Poore, 1976, p. 14).

- Recognize the conflicting role of wildlife populations as both pests and as resources of bushmeat and other products.

- Protect watershed catchments in regard to the quality, quantity, and periodicity of water resources (Dunne and Leopold, 1978; Miller, 1977).

5. Work within seasonal, structural and spatial constraints

   a. Synchronize spatial and temporal structure in relation to seasonal fluxes of flow resources.

      - Seasonality of water supply
      - Seasonality of solar energy
      - Manage flow resources to maximize use of desirable aspects and minimize risk from undesirable phenomena (maximize use of water and solar energy; manage the flow wind to maximize beneficial aspects and minimize wind damage through crop dessication, increased evapotranspiration or wind erosion)

   b. Organize space

      - Territorial structure of society
      - Systems of land tenure

   c. Overcome the challenge of production concentrated in time and dispersed over space with consumption needs concentrated in space and continuous through time.

      - Harvest production and provide storage to overcome the fact that production is concentrated in space and time in contrast to the continuous need for food in the human community whose location in geographical space is more localized in comparison to the area required for agricultural production (Knight and Wilcox, 1976; Carlstein, 1982)

6. Change and climatic fluctuation is to be expected in natural resource systems -

   a. Recognize the seasonal and progressive dynamics of agricultural systems, and utilize on-going processes of productivity increase.

   b. Farming systems are by nature dynamic through given seasons and through successive years, due to such factors as seasonal fluctuations of environmental factors and progressive or secular changes in population density, orientation to cash crops, availability of land resources, and similar factors (Knight, 1974; Kowal and Kassam, 1978; Okigbo and Greenland, 1976; Harwood, 1982; Ruthenberg, 1980).

      - In general, African agricultural systems are undergoing processes of intensification:

        Yields per land unit in the whole agricultural system are increased.

Typically, intensification results in decreased productivity per unit of labor input.

- Intensification is most frequently induced by necessity.

  Population growth with limited access to expansion of the land base

  Circumscription of land resources

  Intensification may also be a consequence of land allocated to market crops when a subsistence enterprise is also maintained.

- Extend intensive compound garden (homestead or dooryard garden) techniques to more extensive enterprises (Okigbo and Greenland, 1976; FAO, 1983).

c. Utilize the annual agro-climatic calendar as an integrating concept for maximizing productivity.

d. Maximize productivity by articulation of agricultural activities in relation to the annual climatic calendar. Farming systems exhibit seasonal cycles of behavior involving fluxes of energy, water, and human activity in response to the annual climatic calendar (Hawksworth, 1984; ICRISAT, 1980; Lal and Russell, 1981; FAO, 1978; Cusack, 1983; Porter, 1979).

- In areas where the length of the climatic season is a constraint on the selection of crops or crop sequences, critical periods in the agricultural cycle such as land preparation, weeding, or harvest may limit the aggregate land in production and thus the overall productivity of the farm unit.

- Climatic seasonality, in conjunction with the diversity of farm enterprises, determines the pattern of labor input needs.

  It is typical that farm labor is a limiting factor during at least one period during the season. Partial and disguised unemployment may occur at other times, with labor available with no obligatory commitments.

  Develop strategies to effectively mobilize this available labor.

Identify and ameliorate labor bottlenecks.

- Climatic seasonality in the lowland tropics is determined by the availability of water to mee plant evaportranspiration needs; thus, the period of photosynthetic activity is constrained by the rainfall (or irrigation) seasonality.

  For this reason, production areas must be, in general, larger in areas of shorter growing season.

  At the same time, the available "window" for field preparation or other activities may, through labor bottlenecks, limit farm size.

- Annual rainfall totals and annual summations of length of growing season may hide patterns of single, double, and (rarely) triple seasons with intervening dry periods sufficient to prevent continuous production of crops unable to draw upon a deep bank of soil moisture or do tolerate dormancy (e.g., cassava).

7. Utilize renewable and non-renewable resources effectively.

   a. Maximize productivity from and minimize dependence upon non-renewable resources (Leach, 1976; Pimentel, 1980; Bayliss-Smith, 1982):

      - In energy-deficit nations, minimize use of technologies dependent on imported petroleum.

      - In petroleum producing and exporting nations, use energy resources for appropriate energy-intensive technologies that are ecologically and economically sound.

      - Minimize dependence on mineral fertilizers and agricultural chemicals based on imported or limited resources.

   b. Maximize system closure to the flow of renewable and non-renewable resources. Close the system as much as possible with respect to the flow of non-renewable resources:

      - Renewable resources should not be used at a rate exceeding rates of regeneration.

      - Renewable resources are mortgaged when regeneration rates are exceeded, but regeneration continues.

- Renewable resources are eroded when use prohibits regeneration.
- Renewable resources can be enhanced, receiving investments to increase resource availability.
- Non-renewable resources can only be mined.

c. Utilize renewable resources for sustained productivity. Effectively utilize and recycle renewable resources such as soils, soil nutrients, and plant productivity with a goal of achieving sustained productivity.

8. Control processes of plant and animal succession.

a. Control succession from desired to undesirable plant and animal communities that would divert environmental resources, using weeding, trapping, guarding, fencing and similar strategies.

b. Provide crop and livestock protection.

- Provide crop and(or) livestock protection from diseases and pests
- Maximize use of biological controls and integrated pest management
- Encourage natural parasites and predators of pests
- In areas with a marked dry season(s), the dry period is a partial control on diseases and pests (Kowal and Kassam, 1978)

9. Use local knowledge and indigenous plant and animal species where possible -

a. Exploit opportunities based on local knowledge and resources prior to introduction of exogenous technologies (UNEP, 1980; Klee, 1980; Richards, 1983; 1985; Brokensha, Warren and Werner, 1980; Farvar and Milton, 1972).

- Understand the implications of new technologies for the entire system, not just for the target enterprise.
- "Decisions on the designation and allocation of land for various uses should be based on as much relevant information as possible" (Poore, 1976, p. 8).
- Use a comprehensive and integrated approach to planning for a region to maximize present and

future use of available resources (Poore, 1976, p. 8).

b. Human societies are central in the development, selection and maintenance of the informational, technological, and genetic information that drives agricultural systems (Knight, 1976; Kowal and Kassam, 1978). Thus local people, technologies, and environmental knowledge must be incorporated in development planning; to achieve success, projects should be planned with people, not just for them. The existing farming system must be thoroughly understood in ecological (as well as technical, economic, infrastructural, and social) terms before change is contemplated (Kowal and Kassam, 1978; Richards, 1983; 1985).

c. Rely on local biological and physical processes as much as possible versus dependency on exogenous inputs that may introduce uncontrollable sources of vulnerability (Altieri, 1983). Redundancy in infrastructural networks sufficient to guarantee reliability of input supply is often lacking in rural areas of Africa.

d. Maintain and develop existing resource investments rather than abandon extant efforts for new projects with new commitments of land and other ecological resources (Eicher, 1986, p. 4).

10. Increase productivity

a. Focus development efforts on food crops that are wanted and best suited for the each region. Many countries don't allow the transportation of goods from one political district to another. This results in the production of crops on lands best suited to other crops or another land use.

b. Increase productivity to the total land area in the agricultural system. Many traditional African agricultural systems are based, at least initially, on systems of extensive rather than intensive land use -- shifting cultivation and rotational bush fallow. Thus assessment of yields must take into account land areas in various stages of the fallow cycle, as well as land actually in cultivation. A similar principle holds when assessing productivity of rotational rangeland use (see discussion of the land use factor in shifting cultivation systems in Allen, 1965; Okigbo and Greenland, 1976).

c. Maintain food-production enterprises even when development is focused on non-food agriculture or non-farm activities.

d. Maintain enterprises producing subsistence food supplies to the producing unit (even though additional farm and non-farm activities are developed).

   - Reduce vulnerability to disruption of external food sources.

   - Reduce vulnerability to food supply related to risks in sources of income for purchase of food.

e. Concentrate development in areas of highest agricultural potential:

   - Focus development in higher altitude areas versus areas at middle and low elevations:

     Develop higher areas with greater potential photosynthesis due to higher light intensities and cooler temperatures than cloudier, warmer lowland areas (Chang, 1968; 1970; Porter, 1979)

     Highland areas often have higher rainfall (orographic effects) and(or) lower evapotranspiration and thus provide more reliable water management.

     High productivity traditional systems (Jones and Egli, 1984).

   - In screening and assessing potential technologies, use agro-climatic and agro-ecological analogies from other tropical areas (FAO, 1978).

   - Utilize floodplain and similar areas with high agricultural potential, while recognizing that flood and irrigation agriculture poses significant risks of water-based diseases such as schistosomiasis (Hughes and Hunter, 1970).

f. Encourage use of animal-based food sources not dependent on inputs competing with direct human food consumption.

g. Utilize animal sources of protein, calories, and fat only when animals mobilize resources not directly usable by human populations; minimize use of animal food sources dependent upon potential human foodstuffs until the basic caloric, protein, and fat needs of the population are met:

   - Use animals to harvest solar energy in areas too arid or otherwise unsuitable for arable agriculture.

- Use animals to collect and concentrate resources in fallow areas and from unneeded crop and processing residues.

h. Develop integrated crop and livestock farming systems that will synergistically enhance both crop and livestock enterprises.

    - Overcome impediments such as animal trypanosomiasis and other insect-borne diseases that limit the viability of animal traction and animal integration with arable crop enterprises in much of seasonally and annual humid Africa (FAO, 1983).

    - Develop integrated crop/livestock systems at scales that are agronomically and economically viable. Even where diseases do not prohibit use of cattle or oxen, scale of farming controls whether livestock traction is economically viable (Kowal and Kassam, 1978).

11. Provide suitable soil physical and chemical conditions for improved plant productivity. Agricultural technologies must provide suitable physical and chemical conditions in the soil so that nutrients and moisture are available to the crop (Kowal and Kassam, 1978). Timing, site selection, soil management, and field preparation, crop selection and other elements of the agricultural system must meet these exigencies. Similar goals are met by range management techniques and herd movement among pastoralists.

    a. Enhance nutrient availability through management of soil reaction (pH).

    b. Use deeply rooted crops and(or) fallow plants to recycle nutrients leached beyond normal arable crop root depth.

    c. Provide plant nutrients for yield maximization (e.g., Okigbo, 1980).

    d. Maintain soil structure for plant root growth and moisture movement (Lal and Greenland, 1979).

    e. Recognize the role of microconsumers and decomposers play in the nutrient cycle. As plants grow, they form protein and carbohydrate substances using the energy from the sun and elements found within the system. These elements (nitrogen, carbon, phosphorus, potasium, etc.) are bound up in plants and the animals that feed on plants even after the organisms death. These nutrients are released into the soil by the action of decomposers where they can be used again. Most soils don't have an abundance of some nutrients and rely heavily upon the action of microconsumers and decomposers to recycle nutrients within the system.

The balance between production by plants, consumption by consumers (including people), and decomposition is of prime importance in low-resource agricultural production. Management practices often alter this balance without the manager realizing the practices impact on the nutrient cycle.

12. Improve productivity to the factor or interacting group of factors that are most limiting. Following Liebig's Law of the Minimum (Odum, 1959, p. 88), improved agricultural productivity requires maximization of the return to the factor (or interacting group of factors) which most limits production (Kowal and Kassam, 1978; Hawksworth, 1984).

13. Water management Next to people, water is the most important component in natural resource management. Mitigate potentially detrimental aspects of tropical rainfall regimes.

    Mitigate potentially detrimental aspects of tropical rainfall regimes. Utilize management techniques to mitigate potentially harmful aspects of tropical rainfall regimes (Lal and Greenwood, 1979):

    a. Use agricultural practices that protect the soil against compaction and surficial erosion related to high tropical rainfall intensities.

    b. Maximize temporary storage of water in the soil to maximize soil water availability, particularly in climatically marginal areas.

    c. Use cropping systems to mitigate the leaching of nutrients.

    d. Prevent excessive waterlogging during the season of greatest rainfall.

    e. On sloped areas with clay subsoils, prevent excess moisture infiltration.

        - This strategy may be as important as preventing excessive moisture loss, because excessive wetting of subsurface clays can lead to slope failure (such forms of mass wastage as slumping and landslides), which may create a more permanent kind of destruction than moderate surface erosion.

f. Maintain traditional low-erosion-risk land preparation methods versus continuous mechanized cultivation of seasonal row crops (Lal, 1982).

14. Provide long term monitoring Foster a commitment to longitudinal environmental monitoring and evaluation that is as important as short-term environmental assessment and allocation in development planning. Environmental monitoring and evaluation must follow environmental assessment and allocation as development progresses (UNEP, 1980; World Bank, 1974).

15. Involve local people throughout the development process - To achieve any level of success projects should be planned with people not just for them. It must be recognized that sub-Saharan agriculturalists don't share the same production objectives as those in western countries. For example, pastoralists have animals for many purposes and the production of red meat is often of little importance.

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Draft

MANAGEMENT PRACTICES	Integrated System	Unit Uniqueness	Energy Flow	Minimize Risk	Seasonal/Structural Constraints	Dynamics	Resource Utilization	Control Succession	Use Indig. Knowledge and Material	Increase Productivity	Soil Phys. and Chem. Conditions	Limiting Factors	Water Management	Monitor Development	Involve Local People
1. LAND ROTATION	X	X	X	X	X	X	X	X	X	X	X		X	X	X
2. FIELD SYSTEMS	X	X	X	X	X	X	X	X	X	X	X		X		X
3. SOIL MANAGEMENT	X	X		X	X	X	X	X	X	X	X		X	X	X
4. MECHANIZATION	X			X		X	X	X	X	X		X		X	X
5. FALLOW MANAGEMENT	X		X	X	X		X		X	X			X	X	X
6. WATER MANAGEMENT	X		X	X		X	X		X	X	X	X		X	X
7. CROP BREEDING	X		X	X					X	X		X		X	X
8. AGRICULTURAL CHEMICALS	X							X	X	X				X	X
9. TREE CROPPING	X		X		X	X	X	X	X	X	X		X	X	X
10. AGROFORESTRY	X		X	X	X	X	X	X	X	X	X		X	X	X
11. LIVESTOCK MGMT. AND BREEDING	X		X	X	X	X	X	X	X	X				X	X
12. GAME CROPPING	X		X		X	X	X	X	X	X				X	X
13. RANGELAND VEGETATION MGMT.	X		X	X	X	X	X	X	X	X				X	X
14. MIXED ARABLE/LIVESTOCK FARMING	X		X	X	X	X	X	X	X	X				X	X
15. AQUACULTURE	X				X				X	X				X	X

Draft

AGRICULTURAL PRACTICES IN RELATION TO PRINCIPLES OF NATURAL RESOURCE MANAGEMENT

The various principles and concepts of natural resource management that are important in low-resource agriculture in Africa maybe seenin the context of whole systems, specific enterprises, and generalized practices. In this context, the whole agricultural system connotes all resources and human activities interacting in time and space to produce food, fodder, fiber, and fuels. Principal concentration is on food production, with some reference to other goals. An agricultural enterprise is a sub-system focused, in the American context, ona specific product. In Africa, an enterprise might better be viewed as an interacting sub-systemdefined by land use and the products that result. Various practices, therefore, appear in various enterprises--weeding, hoeing, mounding are examples.

For this discussion, we organize our presentation by various agricultural practices, suggesting how each practice is related both conceptually to natural resource management concepts and commenting on natural resource implications of each in the African context. Figure 1 presents a summary of how the concepts interact with each practice in matrix format. The following general categories of practices will be considered:

1. Land rotation, systems by which land is brought into and removed from productive activities;

2. Field systems, involving methods for crop production within the individual field;

3. Soil management, including both chemical andphysical properties;

4. Mechanizaion,in whichhuman energyis supplemented by animal traction or engine-driven implements;

5. Fallow management, distinguishing purposeful manipulation of ecological processes on land not presentlyin cultivation;

6. Water management, recognizing considerable overlap inpurpose with field systems and soil management;

7. Crop breding, focusing on specific goals for selection and improvement;

8. Agricultural chemicals, for control of pests, diseases, and weed competition;

9. Tree cropping, which encompasses many of the export market crops;

10. Agroforestry, in which woody vegetation not directly consumed as human food provides benefits to arable agriculture;

11. Livestock management and breeding;

12. Game cropping;

13. Rangeland Vegetation management;

14. Mixed arable/livestock farming, as an extension from either pastoral or farming directions.

15. Aquaculture

The specific practices discussed in each category are listed in Table 1, and are the subheadings bywhich this document is organized.

Table 1. Agricultural Practices.

1. Land rotation
    a. Shifting cultivation
    b. Rotational bush fallow
    c. Rotational grassland fallow
    d. Transhumance (pastoralists)
    e. Migration and migratory drift (pastoralists)

2. Field systems
    a. Intercropping/interplanting
    b. Mixed cropping (multiple enterprises)
    c. Relay cropping (seed through previously standing crop)
    d. Alleycropping/row intercropping/alternate strip intercropping
    e. Multiple cropping
    f. Crop sequences
    g. Crop rotation
    h. No-till planting
    i. Mulching

3. Soil management
    a. Hoeing
    b. Mounding
    c. Ridging
    d. Tie ridges
    e. Bench Terracing
    f. Contour farming
    g. Contour bunds
    h. Green manures
    i. Legume crops
    j. Burning
    k. Animal/human waste
    l. Chemmical fertilizer
    m. Lime

4. Mechanization
   a. Clearing
   b. Field preparation
   c. Weeding
   d. Harvesting

5. Fallow management
   a. Woodland and forest
   b. Grassland
   c. Pasture

6. Water management
   a. Early planting
   b. Irrigation
   c. Drainage
   d. Floodland (flood retreat) cultivation
   e. Seasonally flooded lands
   f. Run-off (seep-zone) agriculture
   g. Water harvesting

7. Crop breeding
   a. Yield
   b. Response to inputs
   c. Tolerance
   d. Early maturity
   e. Photoperiodic insenistivity
   f. Genetic preservation

8. Agricultural chemicals
   a. Pesticides
   b. Herbicides

9. Tree cropping
   a. Plantations
   b. Interplanted arable/tree crops

10. Agroforestry
    a. Fuelwood
    b. Fodder (agrosilvapastoral systems)
    c. Nitogen-fixation
    d. Shelterbelts
    e. taungya systems

11. Livestock management and breeding
    a. Farmstad animals
    b. Herd animals

12. Game cropping

13. Rangeland vegetation management

14. Mixed arable/livestock farming
    a. Agropastoralism
    b. Integrated araable/livestock production
    c. Livestock/plantation intergration
    d. Draft animals

15. Aquaculture

Typical references: Allan, 1965; Carlstein, 1982; FAO, 1983; Greenland and Lal, 1977; Jones and Egli, 1984; Knight, 1976b; Kowal and Kassam, 1978; Morgan, 1978; Okigbo and Greenland, 1976; Okigbo, 1977; Ruthenberg, 1980; Thomas and Whittington, 1969.

1. Land rotation

Land rotation has long been viewed as among the most common and challenging characteeristics of Aftican traditional agriculture. Land rotation includes a number of arable and pastoral practices, all having a common function that periodically land remains unutilized as a purposedful agricultural strategy. Important institutional issues include recognition of land rotation systems as an appropriate adaptation to tropical ecological processes and enhancing research on intensification (Okigbo and Greenland, 1976; Okigbo, 1977; Harwood, 1982).

a. Shifting cultivation
   - Not jsut a tropical phenomena, but occurred widely in mid-latitudes also: common denominator: woodland or forest environments, low population density, hig returns to labor.
   - Although a primary source of staples, often accompanied by more intensive dooryard gardens
   - Simple implements belies complex technology which uses many practices cited below; complex in the sense of environmental knowledge and cropping strategies
   - Important role of plant community structure and species as indicators of environmental potential
   - Hoe/ax/machete; fire as powerful tool
   - Chainsaws in use; hoe largely required for seedbed preparation due to stumps and bolls of trees
   - Ratios of cropping to fallow period are a diagnostic in system classification
   - There is usually a seequence of cropping patterns applied on the land area before abandonment ot uncontrolled fallow; this sequence typically moves from to less nutrient-demanding crop complexes, eg. yams or grains to cassava
   - Natural vegetation recycles/concentrates nutrients mobilized by felling and burning
   - Maintains soil structure; minimizes soil erosion
   - Requires only small non-renewable resources for implements
   - Does not optimize systems closure, but close

- Relies virtually totally on local biological and physical processes
- Closely linked to climatic seasonality in terms of felling and burning (dry season) and cropping (rainy season)
- Patchwork or fields in forests diminishes imapact of soil erosion; dispersion of activities as a pest and disease control
- Use solar radiation to drive work of plant community in recycling/regenerating ecological productivity
- Principal livestock are small stock; cattle important for social purposes, but largely precluded by coincidental occurence of trypanosomiasis

b. Rotational bush fallow
  - More intensive phase of (a)
  - Typically, higher population density
  - Shorter period of uncontrolled fallow; may continue to harvest from fallow period carryover
  - Returns to same/similar field boundaries
  - Important to understand both causes, means, and consequences of chnage from a to b
  - Many ecological benefits similar to a

c. Rotational grassland fallow
  - Highland grassland ecosystems
  - Human-derived grassland from forests
  - Higher population densities and/or prevalence of fire maintaining agrassland vs. woodland (ie. derived savanna ecosystems)
  - Lack of brush regrowth may help control insects and vector borne diseases
  - Often represents shorter fallow and higher yield per total land in system
  - Significantly greater opportunites for livestock enterprises in fallow areas
  - Symbiosis of pastoralists grazing fallow land helps regenerate fertility
  - Patoral activity on fallow land makes use of solar energy
  - Fallow land has protective vegetative cover (eg. versus American "dryland" farming with bare soil fallow)
  - More difficult to open fields due to grass soc; potentials for animal-drawn plows and mechanization

d. Transhumance (pastoralists)
  - Annual migration to seasonal pasture to exploit resources, avoid seasonal expansion to tsetse areas
  - Potential for cultivator/pastoralist symbiosis (Scott, 1984
  - Detailed knowledge systems involving animals and range resources
  - Multiple role of livestock, beyound subsistence value (Schneider, 1974).

- Uses ressource areas unsuitable for or not currently used in arable agriculture
- Adds to diversity of enterprises in mixed farming/pastoral populations
- Provides animal products without consumption of feed grains
- High risk of ecological damage in extreme conditions due to value of animal numbers as social insurance
- Dispersal of owned livestock among several herds as a risk-spredaing strategy (Schneider, 1974)

e. Migration and migratorydrift (pastoralists)
  - Purposeful (migration) or gradual (migratory drift) change in grazing location (Stenning, 1957)
  - Exploitation of previously unused resources
  - Potentials for direct conflict with game preservation activities

2. Field systems

A number of indigenous and modern field management techniques are used in Africa and are subject ot continuing analysis and experimentation. focal to many of the specific strategies is the notion of grrowing more than one crop species in the same area, in contrast to monocropped row crops under pre-industrial animal traction and post-industrial tractor use in the middle latitudes. Many of the more labor-intensive techniques still rely on hand cultivation using hoes, but are the essential elements by which agricultural intensification occurs. a tradition of scientific investigation of field systems is now well-established, but the international agricultural community could strengthen research on practices important for small-scale farmers.

a. Intercropping/interplanting

  - Intercropping involves mixing a number of crop species and varieties in a field at the same time
  - Beneficial plants occupy ecological niches that would otherwise host weed species
  - Complementarity of water, nutrient, and solar energy requirements in time and space allow greater use of flow and renewable resources
  - Mixtures of crops deters spread of diseases and pests (Steiner, 1984)
  - Different crops respond to variations in environmental conditions through the season, helping to ensure adequate food supplies
  - Innumerable intercroping experiments are being undertaken in literally thousands of farming systems
  - Intercropping provides an opportunity for a gradual increase in inputs to provide increasing food needs
  - Patterns of intercropping and crop complementarity appropriate to local agro-ecological circumstances are preserved at the micro-scale

- The productivity of intercropping versus monocropping has been established (eg. Steiner, 1984; Richards, 1985)
- Thus, monocropping must be proven as an apropriate technological alternative, rather than be assumed as such from Western experience
- Crop needs which are complementary in time and space increase the use of flow anhd renewable resources which would otherwise be lsot to beneficial use
- Nitrogen fixation by legumious crops helps to meet nitrogen demands by principal staples

b. Mixed cropping (multiple enterprises)
  - Mixed cropping provides the agriculturalist with a number of enterprises as opposed to a single focus for production
  - Mixed cropping is virtually universal, involving fields at various stages in the cropping sequence as well as gardens, valley bottom, and other activities
  - For African farmers producing cash market crops as well as subsistence needs, mixed cropping is both a blessing and curse, but they will also remove land from traditional food crop land use rotations, perhaps permanently (tree crops--coffee, tea, cocoa, citrus, kola)
  - Mixed cropping provides an opportunity to explore new technologies without necessary risk to the subsistence food supply
  - If mixed enterprises are complementary in land use demands, this strategy may make possible greater potential productivity from land resources and induce intensification in food crop enterprises.

c. Relay cropping (seed through previously standing crop)
  - A variant of the intercropping strategy, in which crops are not planted simultaneously
  - A catch crop of vegetable legumes planted early in the season followed by a staple grain is common in areas with a rainy season of medium length
  - Relay cropping may be a virtual necessity for intercropping under conditions of labor bottlemecks
  - Advantages of intercropping in relation to soil protection and resource use
  - Subject ot considerable current experimental investigation (IITA--Lal, 1982)

d. Alley cropping/row intercropping/alternate strip intercropping
  - A tradeoff between true intercropping and potential use of mechanization
  - Possible combination with agroforestry
  - Parallel to contour strip cropping in middle latitudes

e. Multiple cropping
  - Two or three cycles of planting through harvest operating sequentially on a plot of land in a given cropping year
  - May depend on development of non-photoperiodic crop varieties (hybrid rice, sorghums)
  - Spreads labor demands over longer period of potentially productive use
  - Uses longest possible period of potential photosynthetic activity
  - Makes intensification possible
  - Assists in increasing subsistence production and may make surplus staple production passible
  - Greatest potential on micro-ecosystems of high productivity potential, such as floodplains
  - Diversifies activity
  - Ratoon cropping, protect/harvest volunteer crop in subsequent season (eg. sorghum); some risk of disease persistence

f. Crop sequences
  - Precursor to true rotations
  - Sequences are usually a good indicator of the dynamics of field ecology as cropping progresses, in terms of nutrient availability of land for initial weed problems, and availabiltity of land for initial stages of the cropping seequence
  - A potential basis for actual rotations
  - Usually progresses from most to least demanding crop patterns
  - Often ends with cassava which is highly tolerant of low soil fertility, resists pests, and has relatively low labor demands (at a price of very low protein: carbohydrate ratio)

g. Crop rotation
  - A repeating sequence of crops (or crops and short fallow) that permits sustained productivity
  - May be combined with strategies listed above/below (not exclusive)
  - Great oppotunities for basic idea to be developed in context of tropical environment/crops/technologies
  - Has evolved spontaneously in African agriculture as a strategy for intensification
  - May depend on efficiency of nitrogen fixation, an uncertainty in some tropical conditions

h. No-till planting
   - Requires use of pre-emergence herbicides
   - High risk of human/environmental contamination as well as technical failure if chemicals improperly used
   - Protects soil against high rainfall intensity
   - Conserves soil moisture
   - Risks concerning pests and vermin--may be location specific
   - Helps diminish risk of soil erosion

i. Mulching
   - Soil moisture conservation
   - Soil erosion protection
   - Often used for tree crops
   - Significant risk of fire damaage to perennial crops in areas with sufficiently long dry season

3. Soil management

Management of soil structure, reaction, and nutrients are often viewed as the most significant environmental challenge for African agricultural development. Given the great diversity of both ecological zones and soil parent materials in tropical Africa, few generalizations hold for African soils, any more than they would for soils in the middle latitudes. Important concepts, however, relate to maintenance of soil structure and erosion protection as being more critically important than soil fertility per se; to the generally acidic nature of soils in humid African areas, with pH values that indicate less nutrient availability, even though they may be physically present in the soil (acidity that may be exacerbated by use of chemical fertilizers); to relatively ow levels of exchangable bases (low cation exchange capacity); and to relatively rapid decomposition of organic detritus and rapid leaching of both organic and mineral nutrients (indicating the important role of deeply rooted crop and fallow plants in the recycling of nutrients.

Each of the practices enumerated contributes to the maintenance and enhancement of soil productivity and a potential for application over a wider range of farming enterprises. Many of the more inteernisve soil management techniques are first used in dooryard gardens and later applied to a larger variety of farming land uses.

There is a critical need for studies on nutrient cyclking in tropical soils as well as understanding dynamics of soil erosion processes. Major institutional attention should be given to improving soil management techniques for improved productivity.

a. Hoeing
- The traditional African soil management technology
- Reasonably protective against surface erosion
- Limited exposure to potential drying and hard pan formation
- Somewhat labor intensive, may be a major bottleneck limiting farm size in climatically marginal areas
- Incorporates ash from burn
- Used as a weeding technology as well in fields that are not intensively intercropped

b. Mounding
- Mounding techniques are widespread
- Build by hoeing soil into mounds
- Vary in size from less than 0.5m to over 1m in scale
- In hydromorphic areas to raise root zone above waterlogged conditions
- Prevents waterlogging on upland soils within the root zone of crops
- To provide adequate root depth for root crops on shallow soils aboe hardpans or bedrock
- Incorporates weed and fallow material as green manure
- May be built as weeds are turned under soil
- If combined with burning of dried plant material in the mound, moves pH toward more neutral/basic
- Easier weeding and access through the field
- Increases number of nitrogen flushes as soil is repeated wetted and dried
- Need for more intensive study of laabor/yield trade-off in mounding
- Many variants, not at all well understood in terms of importance for specific problems or whether basically redundant

c. Ridging
- Most of the same functions and technology as mounding
- Elongated patterns
- Very frequently used in African agriculture (eg. matuta Swahili) riging in East Africa
- Open question as to when countour ridging is helpful or detrimental. Hlepful to conserve moisture when rain could be lost to runoff; potentially harmful if excessive rainfall absorbtion leads to landslides or other mass wastage [16c]
- In hilly areas, ridges periodically broken and/or slightly askew to contour may be a solution to this dilemma--more investigation needed
- Good potential for mechanization

d. Tie ridges

- Ridges developed in a grid pattern
- Humid areas—crops on ridges, interstices for detritus
- Dry area—crop on intersices
- Excellent soil and water management technology
- Some systems, location of ridges shifted in subsequent season to incorporate previous aeas in which plant waste and soil collected
- Mechanization difficult if not impossible

e. Bench Terracing

- Terracing occurs in some aeas of Africa as an indegenous technology
- Great variation in scale and permanency of investment
- Traditional terracing by hand labor
- Advanced technologies exist for mechanized terracing in areas with suitable soil and topography
- In this case, however, no longer a small-scale, low-resource system

f. Contour farming

- Implicit in many traditional systems where land use is organized in catenary successions
- Technology is appropriate to mechanized systems
- Technology can be scaled up or down; in U.S. is found in highly mechanized mega-farms as well as small Amish horse farms

g. Contour bunds

- Not indigenous to Africa (?)
- Collects eroded soil and moisture, yet allows mechanization
- Scale independent; suitable even for intercropped systems

h. Green manures

- Inadvertent green manuring common in traditional African systems, typically of plants appearing in uncontrolled succession
- Many ridging and mounding systems purposely incorporate weeds and crop residues
- Opportunity for integration of livestock by seeding of fallow with pasture species

i. Legume crops

- Enhance nitrogen content of soil (Kowal and Kassam, 1978, pp.133-143)

- Intercropped and relay croped legume/grain combinations are common in Africa
- Often a legume is a "catch crop" planted early for vegetable use prior to main crop(s)
- Great dietary importance re: sources of protein
- Many crops suitable animal fodder, as is residue from pulses for human use
- Several promising unexpolited varieties (eg. wing bean)

j. Burning

- Mobilizes nutrients concentrated in living plant community
- Some nutrients volatilized, virtually lost
- Others available in ash
- Intense burn as a control of pests and weeds
- Ash helps to move soil pH toward neutral/basic
- Escaped fire ecologically important by altering vegetation succession toward grassy and fire-tolerant species and communities
- Opportunities to use unconsumed residues as a fuel source
- More complete burning as termite prevention(?)

k. Animal/human waste

- Little traditional purposeful use in most of rural Africa (exception-the densely settled urban zone around some northern Nigerian cities, such as Kano; also in cases of stall-fed animals in some East African societies)
- Inadvertent use by animals grazing in gardens, fields, fallow land
- Many opportunities with some social barriers to manure handling
- Potential linkages to appropriate sanitation and energy technologies
- Helpful re: soil texture and structure, as well as nutrients
- Animal manure derived from uncultivated areas moved from corral (boma--Swahili) to fields is indirect use of resources from a wider area concentrated by work of sun and animals

l. Chemical fertilizer

- Energy intensive; therefore note principle
- Question: availability of crop varieties responsive to fertilizer inputs (see 7b, below)
- Reliability of input, particularly in the rainy season due to transportation disruption
- Need for appropriate analysis of soil at the micro-(farm field) scale, rather than generalized use
- Need for understanding marginal return to additional

fertilizer in one enterprise vs. new application of fertilizer in another

- Risk of creating labor bottleneck, eg. at harvest
- Can have majaor impact on yield
- Question: soil structural changes as a result of fertilizer (and other agrichemical) use to prolong period of cropping before fallow?

m. Lime

- Importance of soil pH for nutrient availability
- As a resource, limited, due to African geologic history
- Energy intensive for production
- Question: micro-scale tradeoffs of pH correction vs. addition of nutrients?

4. Mechanization

Design of mechanization for the field activities and crop processing in Africa is a significant challenge. Mechanized contribution to relieving household drudgery. Apropriate mechanization is being investigated by a number of institutions in Africa, with the goal of overcoming important bottlenecks. Unfortnately, most mechanization is highly scale sensitive.

a. Clearing

- IITA investigaions (Lal, 1982) clearly demonstrate the superiority of indigenous slash/burn methods of land clearing vs. mechanized land clearing with respect to soil erosion and runnoff. Soil erosion is critical on the farm land; accelerated erosion may have major rural or urban impact downstream
- Chain saws already widely in use
- Male outmigration during the season of opening fields might be mitigated by increased mechanized clearing
- More intensive low-resource systems will rely less on shifting/bush fallow systems, thus decreasing the importance of clearing the agricultural calendar

b. Field preparation

- Traditionally by hoe
- Potentials for cultivators/rototillers/tractors
- Need for integration with investigation of soil characteristics

- Potentials for use of animal traction
- Could be crucially important in climatically marginal areas, where major labor bottleneck in field preparation limits aggregate farm size and thus total productivity (in an area where climatic conditions require a somewhat larger farm size for comparable outputs vs. areas with longer growing seasons)

c. Weeding

- Traditionally, hand and hoe
- Ameliorated by intercropping strategies
- Mechanization difficult in traditional intercropping vs. alley/row intercropping
- Not desirable to have soil exposed without cover
- Herbicides may be more energy and economically efficient

d. Harvesting

- Traditionally by blade
- Major opportunites on large-scale monocropped enterprises
- Important opportunity in transport of the harvest vs. actual harvesting in the field, i.e., to maximize labor in the field vs. labor to transport the crop

5. Fallow management

Traditional African small-scale agriculture does not formally manage the fallow period. Natural plant succession occurs, sometimes affected by periodic burning and often affected by grazing. Fruit trees left in the original clearing (or planted as part of the cropping period) will be harvested after abandonment; indeed such trees may be evidence of principal rights to use the land at a later date (rotational bush fallow). Naturally regenerating crops (suich as sorghum) will also be harvested. There are opportunities, then, for more intensive management of the fallow period. The fallow does serve important ecological functions which should be recognized, such as soil regeneration, weed control, hosting bush-meat species, controlling storm runoff, providing fuelwood, and many others. In addition, some African societies selectively manage 'natural' vegetation as a means of pest control (Page and Richards, 1977).

5a. Woodland and forest

- Opportunities to use fast-growing species for fuelwood or timber
- Nitrogen fixing species for soil regeneration

5b. Grassland
- -- African fallow grassland managed by grazing is common
- -- Burning almost univeral
- -- Grassland as host to game and bushmeat species
- -- Dangers of Imperata cylindrica infestation

5c. Pasture
- -- Opportunity to establish pasture as fallow in more intensive systems

6. Water management

Water, along with soil resources, is a major determinant of productivity in African agriculture. No generality applies to African agroclimatic patterns with regard to water. there are areas where water is excessive due to rain or flooding; where it is ample; and where it is extremely limiting, due to amounts as well as timing. Periodic drought, exacerbated by improvident extension of arable agriculture into marginal lands and by overgrazing, has been a significant factor in African famine for two decades. A number of practices are available to maximize the availability or use of scarce water resources--or to ameliorate problems of water surplus.

6a. Early planting
- -- Long an admonition in African areas with short and unreliable rains
- -- Takes advantage of longest possible period of moisture adequacy
- -- Uses early nitrogen flush before leached or lost to weeds
- -- In areas with longer season, 'catch crop' planted early permits potential use of high-risk early rains
- -- Clear, experimentally demonstrated effects of delayed planting in diminished yields (IITA)
- -- May depend on soil friability before thoroughly wetted
- -- Appropriateness needs careful investigation before early planting is encouraged

6b. Irrigation
- -- Many technologies, including gravity, pumping (animal, human, and fossil power)
- -- Many scales, with important role in small scale agriculture largely ignored
- -- Extend season, utilize available dry-season labor
- -- Permit cropping in areas/seasons of highest photosynthetic potential
- -- Appropriateness of engine-driven pumps dependent on energy resources
- -- Question: viability of ground water mining?

6c. Drainage
  - Waterlogging as a problem, especially in valley area
  - Use floodland and coastal swamp areas
  - Many technologies

6d. Floodland (flood retreat) cultivation
  - Cultivate land whose moisture supply has been recharged by flooding
  - Typically, sequential planting as land is exposed
  - Some degree of risk ofhigher flood levels returning
  - Particularly useful along exotic streams in areas with short growing season or as extension of productivity into the dry season

6e. Seasonally flooded lands
  - Frequently used for wet rice, but with poor control over water height (eg. Liberia and Sierra Leone)
  - Significant opportunities for improvement by water control, fertilizing, and improved crop varieties
  - Land used in flooded stage in wet season may be used for upland crops in the dry season (fadama cultivation among the Hausa of northern Nigeria)

6f. Run-off (seep-zone)agriculture
  - Use of the lower part of the valley slope for an early crop (Richards, 1985, pp. 81-84)
  - Areas which trap early runoff from upslope areas
  - Early cropping permits coming to market sooner and higher prices (Richards, 1985, p. 83)

6e. Water harvesting in arid and semiarid zones. Water harvesting refers to a collection of practices that are used to reduce the amount of rainfall lost through runoff. These methods are generally small scale and provide water on a seasonal basis for increased forage production, limited livestock watering, and human needs. Historical evidence shows, for example, that a rough soil surface retards runoff, promotes infiltration, and slows evaporation. Water-harvesting methods that are discussed in this module are water spreaders, pitting, and microcatchments.

WATER SPREADERS. A water spreader is a system for spreading flood waters to irrigate land, to reduce and store sediment, or to obtain deep storage of ground water (figure __). They commonly take the form of a series of dikes across a flat valley (wadi). preferably one with less than 1% slope. Opportunities for successful water spreading are limited.

The goal is to take flood waters from the main channel to one side of the valley, around the end of a dike, then to the other side of the valley where it flows around the next dike. Another design is to join both ends of the dikes to the valley sides and have broad central spillways in the center of each to allow excess water to pass to the next dike and settling basin. The latter design has fewer weak points and is less likely to fail. Basins above each terrace eventually will fill with silt, resulting in a new slope gradient for the whole valley. A break in the dikes then may cause a deep gully where none existed because they were designed to handle the customary flood, but were inadequate for the unusual storm. Successful water spreaders are designed to take all the flow up to a certain amount, and to let larger flows bypass the system without damage.

Dividing large watersheds and flows into smaller ones can minimize damage during unusual storms. Ancient water-spreading systems accomplished this with separate terraces and diversions that could be opened or closed as needed. These terraces kept the volume of flow to small quantities near the source. Other diversions subdivided or concentrated the flows at the entrances to fields.

Small watersheds and short flows yield a higher percentage of the precipitation than do larger watersheds and long flows. This is because of high percolation of water into stream beds.

Reasons for failure of water-spreading systems appear to be inadequate design to handle large flows from the unusual storms, sedimentation that plugs the system causing overflow, and not managing water during each flow.

RANGELAND PITTING. Pitting the soil on land with slopes less than 15% is accomplished with a disk that cuts a pit as much as 15 cm deep and 1 m long, then lifts from the soil for 1 m before it cuts another pit. Pitting is used to trap water where it falls, to increase water percolation into the soil, and to roughen the surface for reduction of wind erosion. The return is increased forage production. Pits fill with sand and silt in a few years, but their effect may last longer because of the increased waterholding capacity of the soil that has accumulated in the pit.

Another use of pitting and contouring is rehabilitation of bare and badly eroded flat land. Pits and contours break soil crusting and, if combined with deep ripping of impervious soil, promote deep penetration of water. Seeding of desirable forages should always accompany rehabilitation operations as extensive as these; otherwise returns are unlikely to repay the costs.

MICROCATCHMENTS FOR WATER HARVESTING. Harvesting surface runoff necessitates a catchment area and a water-storage facility. The efficiency of water harvesting from a catchment area is usually increased in one of four ways (Medina, 1976): by taking advantage of naturally impervious surfaces of rock or bare clay, by altering the land surface by smoothing or compacting, by chemically treating the soil to prevent infiltration, or by using physical barriers as ground covers. Chemicals include water-repellent silicone, paraffin, and salt. Salt causes dispersion of soil particles, resulting in sealing of the pore space at the surface of the soil. A wide variety of impermeable materials has been used to seal catchments, including concrete, sheet metal, fiberglass, plastics, and tar as an emulsion on paper; some of the most effective have been artificial rubber membranes. The importance of properly installing and maintaining all these types of catchment surfaces cannot be overemphasized.

The water-storage facilities for microcatchments fall into three basic systems: excavated basins, bags made of rubber or plastic, and tanks of metal or concrete (figure __). Excavated basins are usually the easiest to construct but they should always be sealed, commonly with clay or the same materials that were used on the catchment surface. Evaporation can be controlled by covering the water surface with polystyrene rafts. Bags of butyl-coated nylon are completely enclosed, offering clean storage and no loss through evaporation and seepage. All of these catchment facilities are subject to vandalism, damage by small animals, sedimentation, invasion by weeds, and earth movement due to changes in temperature and moisture content; thus they must be rigorously maintained.

Water harvesting may be used to increase the water available for individual shrubs or patches of grass. A small catchment, 10 m2 to 100 m2 in size, bounded by dikes with finely scratched basin, has furnished enough water for establishment and production of singly planted fruit trees, saltbushes, and grasses. Grazing should be eliminated during establishment of vegetation. Many techniques are available for the establishment and management of these planted catchments, but soil compaction of the runoff apron and weed control are essential. This type of water harvesting is labor intensive, costly, and justified only for special purposes.

A number of rangeland-improvement techniques are also types of water harvesting. Livestock-watering points are described in module 3 because of their importance as a technique to improve distribution of grazing, but they are also examples of water harvesting. Rangeland seeding can enhance the efficiency of water harvesting by increasing the proportion of rainfall that infiltrates the soil. Prescribed fire can decrease the efficiency of harvesting rainfall and increase runoff and streamflow because of the decrease in vegetational cover. While the aim of some rangeland practices may not be to harvest water in a strict sense, all aim to make better use of water.

7. Crop breeding

Crop yields in Africa are notoriously low, at least as measured in terms of harvest per unit land area. Yields measured in returns to labor inputs or to energy inputs, however, are not so alarming (Leach, 1976). In addition, given the shifting cultivation nature of many traditional African enterprises, if the yield per total unit area in the system is calculated, it is even lower. Two goals thus emerge: increase productivity per land area in cultivation, and increase the land area effectively in use at a given time. This parallels the experience in other Third World areas--about half of the per capita gains are attributable to yield increases and about half to increase in the effective land base (new land into production plus multiple cropping on single-season land). New crop varieties help in the achievement of these results.

7a. Yield

- Selection of crop varieties with higher yields
- Importance of yields with respect to climatic and other sources of variability
- Introduction of new crops
- Higher yields may mean greater soil nutrient loss
- Tolerance of higher yielding varieties to such traditional practice as intercropping
- Dependency of the crops on fertilizer and agri-chemical use
- Pest and disease resistence vs. higher yields
- Hybrid or composite? Ability of farmer to produce and maintain feedstock
- Hybrid may imply vulnerability to external seed supply

7b. Response to inputs

- Crop breeding for better response to inputs, particularly for fertilizer use
- Many comments for a 7a apply here

7c. Tolerance

- Variability in water supply
- Pests and diseases
- Adaptability to specific circumstances; eg. rice varieties for swamp and upland use in West africa vs. traditional varieties used in both

7d. Early maturity

- Makes growing season more reliable
- Crop to market earlier means higher price
- Yield potential under ideal conditions is lower, due to shorter period of photosynthetic activity
- May have risk of pushing double cropping into climatically marginal zone
- Similarly, risk of allowing arable agriculture push further into marginal zones

7e. Photoperiodic insensitivity

- Allows crop to be grown at any time of year
- Thus, facilitates relay and multiple cropping

7f. Genetic preservation

- Wide and largely unexplored variety of crop species and varieties in Africa
- Many crops indigenous to Africa have potential for future development
- Contemporary dispute as to who "owns" genetic material

8. Agricultural chemicals

Use of pesticides and herebicides versus traditional techniques for control is a major issue involving dependency on energy supplies, public health and environmental pollution, and assessment of the economic returns of agrichemicals. Some potential technologies (eg. no-till farming) may virtually require these chemicals; they may also be important in issues of labor bottlenecks.

8a. Pesticides

- Issues of appropriateness
- Development of traditional controls, such as habitat modification and intercropping as alternative

8b. Herbicides

- Appropriateness
- Labor bottlenecks—an easy but risky solution?
- Potentials for development of traditional management techniques for weeding

9. Tree cropping

Tree cropping is common in humid tropical arreas; indeed, many of the common export crops are—tree—crops--coffee, tea, cocoa, rubber, oil palm, citrus, kola. Tres have the advantage of protecting the soil, often having deep roots to utilize both a large soil mosture bank but also deeply transported nutrients. Many tree crops are interplanted, providing on a micro-scale the structural complexity found in indigenous forests. Growing tree crops is already widespread, typically complemented by parallel subsistence crop enterprises. Economic and sociological issues of cash crop production for export markets and of the plantation system are not addressed here.

9a. Plantations

- Significant negative environmental impact with large scale mechanized clearing
- See taungya system (below)
- Question of dependency on fertilizers and agrichemicals

9b. Interplanted arable/tree crops

- Common, with arable crops being part of the sequence that establishes the tree crops and often continuing in the shade of the tree crop (eg. cocoyams).
- Soil coverage continuous until tree crop developed
- Ecological niches potehtially occuped by weeds used by useful plants
- May be especially suitable in high erosion risk areas

10. Agroforestry

Native cultivators in the tropics evolved a system of sequential agroforestry for soils of low fertility referred to as shifting cultivation. Shifting cultivation involves three steps: cutting and burning trees and shrubs, planting crops in the cleared areas for 1 to 5 years, and resting the area for 5 to 12 years to permit regrowth of native vegetation (see figure 21 page 173 of the ASAL book). Shifting cultivation allows nutrient conservation, accumulation, and recycling within the ecosystem. Although this system appears primative and is condemmed by many when primary forest is involved, it can provide a base for future approaches to agroforestry in the tropics.

The agroforestry efforts in Africa that include livestock have generally focused on two areas: growing and using fast growing fooder shrubs and trees, like Leucaena, as a conservation practice; and grazing livestock under tropical tree crops like rubber, timer, coconut, and oil palm. (some examples on page 172 of the ASAL book also use SR-CRSP case study page 102-103 in Byington and Child 1981)

Byington and Child (1981) grouped the numerous approaches being taken to improve forest forage production systems into five management-oriented categories: 1) planting fodder trees and shrubs to slow deforestation in the humid tropics and desertifacation in the arid tropics; 2) producing forage on pine plantations in temperate conifer forests; 3) integrating forage production with tree crops (common in the tropics but also found in orchards in temperate zones); 4) managing forests for production of wildlife used for food; and 5) reducing livestock grazing damage on broadleaf forests in both tropical and temperate zones.

Combining crop, forage and tree production on the same area must consider the different plants need for water, light, nutrients and space as well as the alleleopathic relationships between plants.

The generic term "agroforestry" refers to sustainable management systems that combine food crops, animals, and woody plants on the same units of land, simultaneously or sequentially, and that apply management practices that are compatible with the social and cultural patterns of the local population. Agroforestry aims to increase overall production for the economic benefit of farmers and pastoralists, while avoiding the adverse effects of emphasizing a single product. An additional goal is to manage the trees, crops, and forages in such a way that ecosystem degradation is prevented.

In the humid tropics the major emphasis is on cultivated crops with trees, but in arid and semiarid regions the emphasis is on pastoralism with trees and other woody plants (figure __). However, the use of woody plants is sometimes limited to highly selected sites. Most animal feeds are raised on farms in humid regions, but on rangelands in dry regions. This module is for the drier areas. The "Guidelines for Agroforestry and Mixed Farming Systems" in Lugo et al. (1985) on the humid tropics discusses the systems approach and gives principles that are applicable to the dry rangelands also.

VALUES FROM WOODY PLANTS. Until recently the attention of rangeland managers and researchers was largely directed toward herbaceous plants. Although the value of browse or fodder from woody plants is recognized, browse is still not adequately measured in range assessments. Browse commonly means forage from woody plants including sprouts, young twigs, leaves, flowers, fruits, and even bark. The terms fodder trees and fodder shrubs are synonyms for browse. Comprehensive discussions of the importance of browse trees and shrubs are found in the proceedings of a conference held in Addis Ababa (Le Houerou, 1980). The National Academy of Sciences (1979) described nearly 200 little-exploited legumes, most of them trees and shrubs, of interest in agroforestry. Other lists and descriptions are available for India (ICAR, 1981), Pakistan (Kahn, 1965), and the

West African Sahel (Advisory Committee on the Sahel, 1983). Nutritive values of woody plants are given by Torres (1983) and Gohl (1981).

Values of fodder trees and shrubs go far beyond feed for animals. Plantings may be in fencerows to mark boundaries, as barriers to unwanted brush, and for shade at the homestead. Many human foods come from trees and shrubs, including fruit, and leaves for greens. Acacias and other legumes fix nitrogen in their roots and enrich the soil for other species. Fuelwood and wood for construction are important products. Plantings are made in gullies and on sand to control erosion. The only fodder available during droughts may be leaves, fruits, and bark from trees. Yet the accumulation of knowledge about the culture and management of trees and shrubs in arid and semiarid areas is still in its infancy.

EXAMPLES OF WOODY FODDER PLANT. These examples were selected from among several hundred that could be recommended for agroforestry use. Some 500 species of *Acacia* are indigenous between 30 degrees north and 30 degrees south. *Acacia albida* is a tree up to 20 m tall that grows along streams in savannas and grasslands of Africa and eastward to India. Its leaves begin to grow with the onset of the dry season and are shed at the beginning of the wet period. The pods are large and a mature tree may yield as much as 100 kg of pods each year. *Acacia senegal*, a bush or small tree less than 5 m tall, produces gum arabic. It is also a fodder tree, and both leaves and pods are palatable and nutritious.

Atriplex spp. are often planted and grown as fodder shrubs in near desert conditions (150 mm to 250 mm rainfall per year). Several species are highly palatable and must be carefully managed so that livestock do not overgraze and kill the young plants.

Leucaena leucocephala is a versatile tropical legume used for human food, forage, wood pulp, fuelwood, and soil improvement. Under some conditions it suppresses *Imperata cyclindrica*, an unpalatable and aggressive perennial grass. It mixes with most tropical seeded grasses and should be heavily grazed after it is established. However, more than 30% of *Leucaena* in the diet of livestock causes digestive problems because f the mimosine content.

Prosopis spp. are valuable for grazing, fuelwood, pods, and soil improvement from northern Africa to southern Asia. *Prosopis spicigera* is a prized drought- and frost-resistant shrub or small tree in arid regions from Iran and India.

Taking into account 1) experiences with subtropical grasses and herbaceous legumes that are not adapted to 500 mm of annual rainfall and 2) the above examples of the value of trees to dry areas, it seems logical to encourage the development of desert trees and shrubs, if only on a small scale. However, the culture of these woody plants is little understood, and seeds or young plants are difficult to obtain. Also, woody vegetation can lower water table elevations considerably in arid environments, reducing the amount of water available for wells and other water sources.

PLANTING TREES. Selecting woody species for successful silvopastoral programs is only one of many considerations. The soil must be a suitable depth, moisture, texture, and structure. A choice between seeding or using nursery plants must be made. Compatibility with grazing and crops is important and is likely to affect the density of planting. Almost all the literature on tree-understory relations show that, as shade from the trees increase, forage and browse understory decreases. FAO (1981) has an excellent publication on tree-planting practices in African savannas.

CONTROLLING UNDESIRABLE PLANTS. Control of weeds and undesirable woody plants usually starts with some sort of land clearing. This may range from 1 m2 cleared with a hoe for the planting of one tree to large, extensive clearings.

Fire is a valuable tool when clearing woodland for the first time, but care must be taken to avoid damage to valuable woody plants. Sometimes it is possible with a little hand-clearing to remove fuel materials from the immediate vicinity of planted trees so that a light fire can safely reduce debris. Light fires when the soil is moist have the least effect on seeds, established grasses, and trees. Grazing may take the place of fire if the planted trees are unpalatable, as are teak, the palms, and most conifers. Trampling damage to trees will be small provided overgrazing of the more palatable species is avoided. If the plantation trees or shrubs are palatable and browsed, such as Atriplex spp. and Acacia albida, they will need a growth period without fire or grazing to allow plant establishment. Even after they are established, grazing must be carefully managed.

Chemical control of woody plants was common for three decades following World War II, but recent reactions to adding herbicides and pesticides to the environment have reduced their use. In addition, chemicals are too costly for the small-scale farmer. The preferred methods of plant control in the arid and semiarid tropics are mechanical -- fire and the grazing of animals such as goats and certain game species that browse on the woody species. Browsing by goats increases the effectiveness of fire because they trim the canopy of individual bushes so that grass grows within and under the shrub canopy. This places a source of fuel, and therefore heat, near the woody stems.

FERTILIZING. There is little doubt that fertilizing increases growth rate and production. However, it is doubtful that purchased fertilizers will return their cost. Certainly the expense is too much for the village farmer. Other means exist to increase nitrogen in the soil, such as using manures and planting legumes. The combination of a legume and Rhizobium bacteria on the roots allows the fixation of nitrogen from the atmosphere — part is used by that plant and part becomes available to associated plants. For example, millet and other food crops are grown under the canopy of Acacia albida in the Sahel region because of the fertilizing effects of the nitrogen from the tree. Unfortunately, a number of herbaceous forage legumes that improve the soil do not do well where the annual rainfall is less than about 500 mm.

PROBLEMS

Agroforestry is regarded favorably in the developing world in spite of the fact that large-scale forest plantations have seldom provided much benefit to villagers. In fact, a strong trend to plant trees at the village and small-farm levels has recently developed (FAO, 1982). The demonstrated successes of multiple cropping and the economic benefits, though small in scale, ensure continuing interest and support for development projects that include agroforestry. However, it is dangerous to assume that agroforestry is free of problems. Here are four types of problems that cause failure.

Sociological Problems

- Social acceptance of new farming and grazing practices is foremost — people hesitate to change their ways. Some land traditions do not permit land ownership or private investment in land.
- Another problem concerns ownership and labor.
- Consider the role of women.

Silvicultural Problems

Uncertainties relating to the development and care of forests constitute another group of problems.

Encouragement of agroforestry requires information that does not exist on species combinations, tree spacing, land preparation, and tree thinning and pruning. This lack is on humid areas where forests have been grown and harvested for a long time.

Food and Fiber Crop Problems

A third family of problems involves food and fiber plants that will grow with trees. Species and varieties of food and fiber crops in the developing countries of the tropics and subtropics are exceedingly numerous, but few have been improved through research. Two characteristics of crops on small farms are immediately obvious: 1) If rows exist, they are crooked, and 2) with few exceptions (rice is one) several crops are growing together. This multiple cropping works well — monocultures are unnecessary and frequently unwarranted with small fields and primitive tools. However, the improvement of multiple cropping on arid and semiarid lands in the tropics has been overlooked to a large degree. International aid has tended to push large fields, long and straight rows, and cultivation with large machinery.

Tropical and subtropical pasture legumes have received effective research attention in Australia, where numerous species have been tested with grasses. None of the legumes and few of the cultivated grasses show sufficient tolerance of shade for planting under a tree canopy.

This problem needs research. Where cultivated crops are in rotation with pastures and trees, the forage species must be easily eliminated so that they do not compete with the crops. Most grasses that are now used or that come in naturally are not easily eliminated. This is another research problem — and there are many more.

10e. Taungya systems [1,7,9,11,12,16,17,18]
- — Developed in Southeast Asia to establish plantation crops: shifting cultivators clear forest, have period for arable production and establish plantation crop, move tonew land when tree crop is established
- — Being used in Liberia to establish fuelwood/timber plantations of Caribbean pine: marketable rainforest trees harvested, forest cut for charcoal and shifting cultivation of upland rices; pine planted
- -- Uncertain future of shifting cultivators if land is limited

11. Livestock management and breeding

11a. Farmstead animals
- — Important in all of Africa
- -- Typically subsist on food processing and food wastes plus foraging on crop and fallow land
- — Small but important contribution to human diet
- -- May play important role in local sanitation
- — Increasingly important as a source of meat/eggs for urban elite

— Emergence of feeder industry (eg. Nigeria); violates principle

11b. Herd animals

Livestock production objectives differ according to degree of commercialization, alternative feeds available, land tenure, custom, and other factors. Of these probably the degree of commercialization is the most important to him. The degree to which he directly uses milk or meat from his herd, or uses the herd as a form of insurance or savings, often determines the degree of commercialization. The nomadic pastoralist depends on his animals to furnish food for his family and has quite different management objectives than the rancher who depends on sales for his livelihood.

Management choices are increased by the availability of alternative feeds such as concentrates, cultivated pastures, hay, etc. But livestock production in developing countries is characterized by an almost total dependence on forage, including browse, for animal feeding. Most of that forage must come from rangelands, although use of crop residues and supplementary pastures and even conserved forage will no doubt increase. This dependence on rangelands and the complexities associated with these lands strongly influence existing management objectives and limit the available alternatives.

A management practice becomes a custom or tradition due to the role it plays in reducing risks. Therefore, a change is not acceptable if it is perceived to increase risks -- which are always great on arid and semiarid rangelands. Perceived risk accounts for certain practices such as stocking more heavily than desirable from the standpoint of range conservation, even when that practice reduces productivity. It also accounts for the ready acceptance of the nonrisk practices such as vaccination of stock against known disease.

The above factors that influence management objectives and practices are far from inclusive. They do, however, indicate the need to assess existing production systems and the production objectives and practices that guide these systems before embarking on a program for improvement through management and breeding.

ISSUES. In developed countries, animal breeding has been primarily aimed at improved productivity, e.g., more rapid growth and higher rates of reproduction. During the last several decades hybrid vigor (through crossbreeding) has been used extensively with great success. Animal breeding has included importation of exotic breds as a further means for increasing hybrid vigor. Wide use of proven sires and artificial insemination, especially in dairy herds, has led to a steady and notable increase in production per cow.

Increases in production have been achieved through some increases in the efficiency of feed conversion, but mostly it has been a matter of increased energy intake and reduced energy losses. Advances in performance have been accompanied by continuously improved management, especially of nutrition. In some countries, especially the United States, this has included the feeding of enormous amounts of concentrates to augment energy intake. However, this increases the production of fat in proportion to lean meat, which may not be the objective.

On rangelands in developing countries the constraints on feed, water, and management severely limit the improvement of productivity through breeding. These constraints usually reduce animal responses well below the potential represented by available genetic material. Furthermore, periodic severe stress resulting from feed scarcity may make longevity the primary characteristic influencing productivity.

Limitations on feed intake as well as genetic makeup result in low milk production. The widespread use of milk for subsistence may make the duration of lactation more important than dairy yield. Similarly, a certain consistency of production (and reproduction) may be more important than quantity, especially in the fluctuating environments of arid and semiarid regions.

Management practices in developed countries are often predominantly concerned with improved productivity. Productivity improvements are mostly achieved for range livestock through nutritional management by increasing primary production, using that production effectively over the year, and taking into account differences in animal requirements and potential economic benefits. Generally one-third or more of the feed such as hay and concentrates comes from sources other than range. Breeding is strictly controlled so that the birth of young is limited to the period of the year most favorable for meeting the high nutritional requirements of nursing animals. Practically no milk for human consumption is produced on the range and beef herds are sharply reduced in size annually (usually in the fall) by sales of calves and young stock. Young stock from the range are sent to improved pastures or feedlots. As a result, beef animals are usually ready for slaughter before they are 2 years old.

In developing countries with well-developed market economies, the emphasis is also on maximizing productivity from the rangelands. Management to relate animal requirements to forage supply is more lax, and supplementary feeding for the season when range forage is scarce is limited. Fattening is not practiced in most countries (although this may change). Therefore, animals may not be marketed until they are more than twice the age at which they are sold in developed countries. Annual offtake is severely reduced. For example, cattle offtake in the United States is around 40%, whereas it is generally less than 15% in developing countries where rangeland is the main source of feed. This means, among other things, that the reduction in the feed consumed by the herd during the most difficult period is much less than in developed countries.

Where subsistence production is practiced, as in much of Africa, the need to maintain a milk supply over the whole year for family use places certain imperatives on management that are vastly different from those of a market-oriented, beef-production system. Most critical is the need to maintain adequate forage in spite of highly fluctuating rainfall. This necessitates an inordinate amount of movement to adequate forage areas, a mix of species, and a herd structure in which adult females dominate. Furthermore, breeding must be such as to provide milking animals over as much of the year as possible. Intervals between breeding must be extended to lengthen the period of milk production, and to allow the milking animals to recover.

Some range-development activities will continue to improve upon the enduring subsistence systems. In most cases, however, the task will probably be to assist in bringing about an orderly and sound transition toward a more market-oriented economy.

In summary, breeding and management practices must fit the environment, be a function of the objectives of the producer, and take into account trends and national needs. For this reason, it is essential to understand the nature of the existing ecosystems, the degree of dependence on these ecosystems by the human and animal components, and the related production objectives. An understanding of these relationships will facilitate the transition from one set of relationships (level) to another.

Benefits from breeding and management depend upon an improved productivity of the entire ecosystem. For this reason programs for animal breeding and management should be considered as components of ecosystem management and should be an integral part of overall rangeland development. Therefore, program/project planning teams making the assessment must have diverse skills and enough experience to make judgments with relatively limited data.

Production systems have evolved as ways of meeting human needs within existing cultural, abiotic, and biotic environments. These systems tend to be rather stable and resistant to change -- especially in the more traditional setting. Nevertheless, virtually all systems could profit from improvement. The type of improvement possible will depend on the specific characteristics of each production system.

Management objectives in different production systems may vary greatly. For example, subsistence systems in which milk for direct consumption is the main product aim at having milk available during the whole year, with some possible substitution of blood or meat, thus providing regular food to family members. At the other end of the scale, consider a commercial beef farm -- its objective is to produce as much meat as possible at a maximum profit. In either case, close consideration must be given to establishing the best possible relationship between animal requirements and forage supply consistent with the basic objectives. This is accomplished through controlled animal numbers, manipulating herd structure, regulating breeding, conserving forage, etc.

Animal management takes into account animal requirements and production objectives and how these can best be integrated with the feeds available. Information about the following is required to improve animal management:

- seasonal distribution of range forage and its approximate composition -- grass, shrubs, and herbs
- variation of the timing and severity of drought
- response of different species to those variations, including weight changes, carcass weights, age of maturity, mortality, etc.
- alternative sources of feeds, supplementary pastures, crop residues, etc.
- marketing or other activities that help or hinder adjustment of animal requirements to the feed supply
- ability of animals to tolerate heat stress and local diseases

This information can be used to identify management deficiencies and can suggest corrective action, which involves manipulation of herd requirements or the feed supply or both. Such actions may include reducing animal numbers, changing species or their proportions, changing the breeding schedule, etc. (see Child et al., 1984, for a more detailed discussion).

The pastoralists who will participate in the livestock management and breeding projects should also be involved from the preparatory stage on. They know what their current practices and problems are, and whether or not certain changes actually could be made. But perhaps most important, this type of project implies behavioral changes on the part of the pastoralists. They will not make such changes unless they understand the relevant personal benefits and possibly not unless they feel a rapport and confidence (which cannot be achieved immediately). Major changes should not be proposed until the locally relevant technical and economic aspects are understood.

In general, avoid technologies that involve a permanent and sophisticated support system. A good example of such a troublesome technology is artifical insemination, which requires specially trained staff, transport, refrigeration, semen, etc. Breeding programs must be appropriate to the level of management and feeding. Improved genetic material is of value only as the feed supply and management permit expression of the added potential. Even such a simple technology as a system for dipping animals sometimes strains the support system.

One practice that should be widely used is systematically culling or castrating undesirable animals. This selection process can be adapted to any environment and any production system. Selection of improved, adapted sires is another way to improve a herd. It requires a high level of organization and record keeping, and so is not feasible in some countries. However, importation of nonadapted but highly productive sires and crossbreeding require highly sophisticated management and support organizations to be effective, as well as much better feeding than is available on most arid and semiarid rangelands in developing countries.

Management should be particularly directed toward reduced feed shortages, optimum range use, and grazing schedules that favor animals within the herd that have higher physiological requirements (such as milking animals) or economic value. This implies control of grazing intensity to avoid heavy grazing while providing the best grazing for young animals being fed to market size, breeding animals during the breeding season, and milking animals. The management plan must also consider ways of ameliorating the effects of drought and differences between animal species. In summary, the basic aim in management must be to find the best possible relationship between the animals and the forage supply in order to meet production goals.

12. Game cropping

In developing countries, managed game-cropping systems are often neglected in favor of more conventional resources and industries that satisfy immediate needs. Consequently, government agencies that are responsible for management of wildlife are often poorly staffed and funded, and sometimes lack scientific leadership. Moreover, except for those countries where tourism in game parks and surrounding areas provides an important source of foreign exchange, governments pay little attention to wildlife.

In some regions, past decimation of wildlife has left the countries bereft of industries and production systems in which wildlife habitats can compete with other forms of land use, when a cost/benefit analysis is applied. Besides, the desperate need for development of the land, and natural and human resources for producing food, education, health services, transportation, communications, energy, and other essentials of life are understandably a priority with governments.

Wildlife is sometimes considered detrimental to development. Various species of large mammals and birds compete with domestic livestock for food and depredate crops and stored grain and fodder. Many of the larger carnivores are serious predators of domestic animals, and some animals carry or harbor diseases that affect both man and his animals. Some wildlife directly threaten man.

Wildlife should be managed for the benefit of the people and protected for its own sake. It can instill a sense of patriotism and pride in the people. It can provide recreational outlets for the citizens of the country as well as for tourists. Where wildlife has not been decimated, it can provide food and a source of income for the local populace as well as benefit regional and national economies. Income can be derived from sport hunting, tourism, and the sale of meat and other products from animals harvested in cropping and culling programs.

Cropping of large herbivores in organized schemes was first done experimentally in Africa in 1959 and 1960 by Dr. Raymond Dasmann on the Henderson Ranch in what was then southern Rhodesia (Dasmann and Mossman 1961; Dasmann, 1964). The experiences and reports of Dasmann and his colleagues precipitated widespread interest in cropping of plains game. Subsequently, cropping of wildlife for meat and for revenue, as well as to reduce populations of large mammals that were destroying crops and forage, spread to many countries in southern and eastern Africa.

Cropping of elephants and various other species in the Luangwa Valley in Zambia (Steel, 1968) followed shortly. Elephants and hippos (Hippopotamus amphibius) were cropped to reduce their numbers in Queen Elizabeth and Murchison Falls National Parks in Uganda by I. S. C. Parker and his associates in the 1960s (Parker and Laws, 1970). Other experimental cropping programs were conducted by L. H. Blankenship et al. (in press) on the Akara and Kekopey Ranches in the Rift Valley of Kenya in the early 1970s.

For several reasons cropping in East Africa failed in many areas where it was attempted. Most of the reasons were economic but some were political and a few were biological. Among the more important reasons were poor transportation and refrigeration facilities for the meat, distant and undependable markets accessible only over very bad roads, and unacceptable competition with the livestock industry. In southern Africa, on the other hand, cropping of animals from free-ranging herds of plains game, but also of bush-dwelling species, has been successful. A great many ranches in Zimbabwe, South Africa, and southwest Africa crop game for sale in markets at home and abroad. Joubert et al. (1983) report on an effective and profitable cropping scheme on private ranches in southwest Africa. In this scheme much of the meat is being sold abroad, but some is being processed -- refrigerated or dried -- and sold in the local markets. This seems to be the pattern of marketing in most recent schemes.

Some argue that the most efficient and cost-effective method for providing meat from wildlife is to permit local people to practice subsistence hunting, a long-standing tradition in many regions of the world. Distribution, marketing, and goals of cropping may be met in this manner, but uncontrolled harvesting (poaching in the strict sense) can result in impoverished populations of target species. Ultimately the potential for sustained yields of meat and the industry surrounding it may be lost.

Biological Guidelines. Concentrate game-cropping schemes on species that are herd animals have relatively high reproductive rates, weight at least 10 kg to 15 kg, and are sufficiently abundant to support a reasonable annual offtake.

THE FUTURE OF GAME CROPPING. Wildlife can be expected to provide meat for some time in the future in areas where domestic livestock cannot be raised profitably or efficiently. Some regions of the world can support wildlife more efficiently than domestic animals because wild species have evolved and are adapted to the extreme environmental conditions found there. The deserts and cold regions of the world are likely to remain wild environments and livestock will be used there only when every other favorable rangeland has been filled.

However, in areas where conditions (such as the presence of parasites) prevent conventional animal agriculture, cropping of wildlife for meat in wildlands can be expected to give way to development of a domestic livestock industry. Technology will eventually solve the management problems, and domestic animals of one kind or another will be used in extensive production systems. They are more manageable and have sufficiently different dietary requirements to use practically all classes of forage.

Producing livestock and wildlife on common-use rangelands may offer the highest potential for profit. The technology for integrating systems of management is not well developed yet, but with continuing world food and population pressures, management systems will be developed. The greatest value of wildlife will probably be as objects of tourism and sport hunting.

13. Vegetation management

a. Management of the natural vegetation through grazing, water and livestock distribution, and fire.

Although many plants have evolved mechanisms to resist or avoid heavy defoliation through grazing, not all plants are successful. Defoliation beyond a fairly conservative level reduces the ability of grazed plants to compete with ungrazed or lightly grazed plants by reducing photosynthetic tissue and root growth. Heavily grazed plants do not have the ability to grow at a maximum rate or to reproduce at a rate necessary to ensure their presence in the community. Eventually, these palatable plants may be replaced by more vigorous, less palatable species. Such patterns are all too common on rangelands around the world.

b. Manipulation of the vegetation through seeding and planting forage or fuel species (include Jojoba and gum arabic)

Desertification and natural resource degradation by excessive numbers of livestock and related factors is becoming a worldwide concern. In many cases, simply a lessening of the destructive factor may not result in a restoration of the formerly productive condition. Direct seeding or revegetation may be necessary to restore some of these areas.

Seeding has been used successfully in many areas of the world to improve conditions for livestock grazing and for other purposes. However, seeding is a difficult, expensive task fraught with many uncertainties, which should never be used as a substitute for proper management. Poor management can ruin the best seeding operation. On the other hand, seeding does offer a direct method for increasing primary productivity or quality of forage for selected animals within the herd.

Many principles and general guidelines have been developed for seeding rangelands. However, these guidelines need to be modified before they can be applied in a specific situation.

ISSUES. Rangeland seeding is done for a variety of reasons. They include, but are not limited to, the following (Heady and Heady, 1982):

- to improve the nitrogen status of soil and plants by the use of legumes
- to improve the forage available for herbivores and the nutritive quality of forage, especially for late dry season grazing
- to establish herbaceous cover following brush control
- to establish vegetational cover on abandoned farmland
- to stabilize areas susceptible to erosion
- to increase flexibility in livestock management

On low potential land (rangelands), reasons 2, 5, and 6 are probably the most common.

Analysis of the need for and feasibility of range seeding may be illustrated by a series of questions (Heady, 1975).

- Is seeding necessary?
- Is the climate suitable?
- Is the habitat favorable?
- Is proper management possible?
- Is the necessary equipment and seed available?
- What species should be seeded?

Legumes are usually included in pasture seedings. Under range conditions, legumes are difficult to establish and to maintain when grazed. Opinion is divided as to whether legumes should be used in range-seeding projects. There is also a question of seeding mixtures (more than one species or even different plant forms) versus single species. The advantages of seeding mixtures are as follows (Heady, 1975):

- Mixtures often produce better animal performance than do single species.
- Mixtures often extend the green-feed period because they contain different species with different growth periods.
- Mixtures may allow more efficient use of soil water because the component species have different rooting patterns.
- Mixtures represent the optimum chance for different microsites to receive seed adapted for growth there.
- Symbiotic relationships are formed among the species in a mixture.
- The species contained in a mixture will not all be eliminated by a disease or parasite, whereas a single species may.

However, single species also have certain advantages over mixtures.

- Less time and money are necessary to obtain the seed and get it ready for planting.
- Drill seeding is easier.
- Seed harvesting is easier.

- A single species may be better adapted to a harsh site than mixtures.
- Single species are easier to manage under grazing because less palatable species tend to increase in mixtures at the expense of more palatable species.

In range seedings, the emphasis is generally on grass or legumes. However, do not overlook shrubs and small trees. They often provide a valuable source of protein and minerals in the dry season when grasses are decidedly deficient in these nutrients. Shrubs can be used in small plantings for special purposes at specific sites. Shrubs and trees may be directly seeded or transplanted. Techniques have been developed for successfully planting many species of trees and shrubs (see module on agroforestry). Several sources present lists of species that might be used in seedings for various areas (Heady and Heady, 1982; Pratt and Gwynne, 1977).

Several general principles for successful seeding have been developed.

- Remove or reduce competing plants.
- Use either native species or introduced species that have been tested for the area.
- Seed at the proper time.
- Prepare an adequate seedbed.
- Use the proper amount of seed.
- Use an appropriate seeding method.
- Plant seed at the appropriate depth.
- Restrict grazing for one or two seasons to allow plants to become established.

14. Mixed arable/livestock farming

14a. Agropastoralism
- Builds from pastoralism to include arable agriculture (FAO, 1983)
- Distinguish true interaction of arable and livestock subsystems vs. emergency of arable enterprise among societies previously distaining farming (East Africa)

14b. Integrated arable/livestock production
  - Builds from arable agriculture (FAO, 1983)
  - Some pre-colonial examples (eg. Wanyakyusa, Tanzania)
  - Examples from Kenya and Malawi
  - Historical example from Jamaica of "fly penning": use of portable corrals relocated around fallow and young sugar plants for fertilizing the crop; potential use as alternative to complete fencing for rotational grazing

14c. Livestock/plantation integration
  - Examples from (FAO, 1983)

14d. Draft animals
  - Refer also to comments on mechanization, above

15. Aquaculture

CASE STUDY 1 — Intercropping

Richards (1983, p.17) has termed intercropping "one of the great glories of African science." Intercropping occurs widely throughout Africa, both in major staple enterprises and in household gardens. Evidence of the ecological suitability of the intercropping strategy can be shown both in controlled scientific experiments and indirectly in terms of returns to agricultural inputs and population densities supported using intercropping.

Some of the world's densest rural population densities occur in southeastern Nigeria, among the Igbo and related peoples. Densities exceed 600/sq.mi., or less than 1/2 hectare per capita. There have been a number of studies which document the agricultural systems of this region (Igbozurike, 1971, 1977, 1978; Lagemann, 1977; Floyd, 1969; Uzozie, 1971). Crops are intermixed in fields according to sequences that exploit yield potentials of specific soils; relay cropping is common, with a number of crops used in various combinations: yam, maize (early and late), okra (early and late), pumpkin, cowpeas, cocoyam, cassava, and a number of specialty crops (Uzozie, 1971).
The land is used virtually continuously, with a frequent tree component of kola, citrus, oil palm, and banana/plantain. Soil coverage is maintained, with crops allocated by micro-scale differences in soil characteristics and preparation (eg. mounds). Igbozurike (1978) evaluated the economic returns to polyculture (intercropping) vs, monoculture in a group of eastern Nigerian communities, finding a fairly consistently greater ecomomic value from intercropping enterprises. The intercropped systems

continued to rely on simple tools (machete, pole-digger, and hoe) with little or no energy subsidy (fertilizers, chemicals).

The high productivity potential of intercropping has also been explored through field trials. A particularly useful measure is that of the Land-Equivalent Ratio (LER). This is the "relative land area under sole crops that is required to produce the yields achieved by intercropping" (Steiner 1984, p.83). Numerous studies have shown significantly higher LER under experimental conditions, such as 1.24 to 1.33 for intercropped maize and groundnuts (peanuts) vs. monocropping (Steiner, 1984, p.84). In addition, studies have shown that intercropping reduces variability in yields, with variability declining with the number of crops planted (see studies cited by Steiner, 1984).

In general, intercropping provides better resource use, increased and less variable yields, reduced crop losses (and attendent need for protection), soil fertility maintenance, more balanced labor requirements, and diversity of food sources (Steiner, 1984, pp.212-218). Improvements applicable to development of low-resource agriculture include: optimization of the spatial and temporal cropping pattern, chosing crop combinations to increase yield, selection and breeding for intercropped systems, development of fertilizer recommendations for intercropping, and integration of trees (eg. alley cropping). Challenges include maintenance of a continuous ground cover, biological pest and weed control, and development of appropriate mechanization (Steiner 184, pp. 218-233).

[OTA should make intercropping a major focus in document]

CASE STUDY 2 — Indigenous Pest Control

Insect pests are a challenge to agricultural production in Africa as elsewhere. Page and Richards (1977; see summary in Richards, 1985, pp.146-149) have documented indigenous control of the variegated grasshopper (Zonoceros variegatus) in south central Nigeria. The Yoruba-speaking people of Ikale produce yams, cocoyams, and cassava in a rotational bush fallow dominated by oil palms. Other tree crops as well as plantation-managed oil palm have been established. Ikale experimentation has addressed issues of reduced fallow, declining fertility, and labor supply, resulting in new crop mixtures, increasing use of cassava, and experimentation with growing yam from seeds. In addition, the Ikale people proved to know much about the variegated grasshopper, which had become a major pest of cassava and early maize and bean crops in the 1960s and 1970s (Richards, 1985, pp.106-111).

The Ikale people are able to identify detailed aspects of the reproductive ecology of the grasshopper, and had, according to Page and Richards (1977), anticipated many aspects also identified by a scientific study by the London-based Center for Overseas Pest Research.

By identifying and later digging up the egg laying sites of the female Zonoceros, farmers can have a major impact on subsequent grasshopper populations, particularly since the life-cycle of the insect is completed at a micro-spatial scale. Farmers able to identify sites through knowledge of the insect breeding habits and site preferences could locate sites up to

3-4 km distant from their farms. Many elements of a potential regional control program were already in place, needing only coordination at a scale beyond the individual farm and community.

Richards (1985, pp.146-149) argues that local knowledge was particularly useful in informing the scientific investigation of the grasshopper, particularly concerning historical patterns of outbreaks and potential relationships to rainfall patterns and minor crops. Richards observes that coordination between the role of the scientist and local ethnoecological knowledge can provide opportunity for insect control (Richards, 1983, p.51).

CASE STUDY 3 — Agropastoralism

Agropastoralism--the inclusion of arable food crops in the farming systems of pastoralists--is common among the Fulani of northern Nigeria, constituting perhaps one-half of the Fulani population (FAO, 1983, p.14). Among factors contributing to the development of agropastoralism have been better access to crop residues, problems caused by drought and disease, encroachment by farming popuations, migration routes cut by development, sanctions against cattle movement (tolls, quarantines), need for access to services, and receiving cattle as labor payment for herding farmer's cattle (FAO, 1983, pp.14-15). There were frequently quasi-symbiotic pastoralist/agriculturalist relationships with some advantages of mixed crop-livestock farming (Scott, 1984, pp.72-74).

Traditional Fulani pastoralism included transhumance, in which the cattle were moved seasonally northward to escape expansion of the tsetse belts (and risk of nagana, animal trypanosomiasis) and to utilize seasonal water and grazing resources (Stenning, 1959). In the dry season, cattle were moved to permanent water sources, often grazing the fallow and stubble of arable farmland. As transhumance patterns were altered, migratory drift allowed herders to spread to new areas; purposeful migration also accompanied religious conquests, local disputes, and climatic variability.

Sedentary agropastoral Fulani have adopted the farnming techniques of the local community, but have been willing to experiment with new variations, particularly those combining arable agriculture with use of manure. Crops adopted include a variety tolerant of varied local soil conditions and regional climatic variation, from yams, cocoyams, and rice through sorghum and millets (Digitaria). An appreciable reduction in the incidence and virulence of trypanosomiasis may be due to the habitat changes related to more intensive bush-clearing and arable agriculture, as well as lessened exposure to varied strains of the disease with the cessation of transhumance. A major impediment has been low herd productivity, largely attributable to overgrazing in semi-arid areas and to poor quality of the available forage in sub-humid areas.

Improved productivity of both the arable and livestock enterprises could result from (FAO, 1984):

(1) development of explicit national policies for integrated crop and livestock production;

(2) integrated extension services;

(3) improved forage production, particularly the inclusion of legumes in fallow production;

(4) stall feeding of fewer cattle;

(5) use of animal traction on arable enterprises;

(6) disease control and research;

(7) improved animal nutrition, including more effective use of crop and processing residues; and

(8) more intensive animal fertilizer use; and

(9) intercropped grain/forage systems.

As land becomes increasingly constrained, agropastoralism could be fostered among groups like the Fulani; however, the arable enterprises remain focused on subsistence production, which is said to limit acceptance of innovations in arable agriculture.

CASE STUDY 4 —Tie Ridges and Terracing

Control of soil erosion and maximizing available water resources are important goals for low-resource agriculture in Africa. Indiscriminate introduction of apparently positive technology, however, can have disastrous results. In the Uluguru Mountains near Morogoro, Tanzania, were settled by lowland shifting cultivators. The creation of a forest reserve under the Germans increased pressure on the arable land, with extension of farming onto steeper slopes and with shorter fallows. Considerable sheet erosion followed.

Ladder or step terracing, created by hoeing similar to that traditionally used for tie ridging, was emphasized by the British in the 1930s. In the 1950s, wide bench terraces were introduced, with families being required to construct 500 sq.m. of terraces. There was considerable local resistance to this scheme. There is some cited evidence that the required terraces were put on poorer sites as a way to protect more valuable farmland.

During the 1960s and 1970s, landslides emerged as an even more severe threat to environmental productivity than sheet erosion. It is likely that bench terracing--and even perhaps the smaller step terraces and traditional tie ridges--contributed to landslide risk. Subsurface water pressure is increased by the water retention capability of these soil management techniques, with bench terraces posing the greatest risk. Studies of the land management problem in the Uluguru Mountains are reviewed by Ahn (1977).

There are traditional practices elsewhere that could overcome the kind of landslide risk which was unintentionally enhanced by bench terracing in the Uluguru Mountains. In the highlands of Puerto Rico, for example, this writer has observed steeply sloping hill land with a criss-cross pattern of drains set at an angle to the slope. Local farmers explain this as a way to encourage infiltration of limited rains, particularly at the beginning and end of the major rainy season, and yet to provide drainage of high intensity rains. Moderate surface erosion is apparently a reasonable choice compared to landslides. This does not address whether such sloped land should be cultivated at all.

Similarly, this writer has observed tie ridges (Kiswahili, matuta) in some areas of East Africa which are not on the contour. Such a pattern may serve the role of the Puerto Rican field patterns, in terms of protecting against landslides. During the British colonial period, farmers were urged to put ridges on the contour, rather than 'askew,' which suggests that non-coutour ridging may have been widespread. Ridges placed off-contour with periodic breaks could enhance infiltration from small storm events, yet facilitate drainage from major events.

Given the important role of highland areas, often having exceptionally productive soils of volcanic origin with cultivation on sloped land, much study needs to be done about appropriate soil management techniques to maximize water availablility, minimize soil erosion, and yet prevent disastrous landslides.

CASE STUDY 5 — Environmental Impacts of Land Preparation

Traditional land clearing and soil management techniques are important in the conservation of soil and management of water resources in Africa. Do traditional techniques of clearing help to minimize soil erosion? Do they provide positive hydrological benefits? Studies by the International Institute of Tropical Agriculture (IITA, 1981, 1982; Lal, 1982) have compared traditional with mechanized clearing techniques.

IITA experiments included investigation of traditional farming techniques, manual clearing with and without tillage, and mechanized clearing with shear blades and tree pushers, again with and without tillage. Traditional farming included incomplete clearing by manual methods; manual clearing was followed by burning. Conventional tillage included plowing and harrowing, under both manual and mechanized clearing.

Higher runoff and soil erosion occurred under the mechanized methods, although IITA found that post-clearing management also had a major effect on the rates of runoff and soil erosion, with lesser impacts using no-tillage techniques. Greater planting densities of cassava were achieved under mechanized clearing due to lower seedling mortality in the absence of tree shade typical in the traditional farming methods (IITA, 1981, 1982). Overall, runoff and soil erosion were two orders of magnitude greater under mechanical clearing and conventional tillage versus traditional farming or manual clearing with a no-tillage soil management strategy. Although the degree of soil compaction was initially lower under plowing, by harvest raindrop impaction, crusting, and consolidation resulted in similar bulk density measures. The influence of initial clearing methods decreased after several cropping years (IITA, 1982, p.8).

The importance of hydrological changes as a result of land clearing and subsequent land management is not limited to the farm site. Runoff can lead to loss of moisture that would otherwise be available later in soil moisture storage. Moreover, it can contribute to significant changes in downstream hydrology--an increase in the frequency and severity of flooding. Such phenomena are important not only for agricultural land use, but also for human settlements located in valleys.

Research needs in this area include investigation of the impacts of forest clearing on a variety of soils and topography; of the use of crop residues and other mulches for moisture conservation and soil protection; of the effects of soil erosion on crop productivity; and of the hydrological consequences of various cropping, plantation, and pasture strategies (Lal, 1982). Since traditional farming methods are labor intensive, mechanization offers both relief from tedious labor needs and also may address problems of labor bottlenecks. Both the short- and long-term consequences of mechanized clearing must be better understood. In the meanwhile, traditional methods appear to have continuing conservation potential.

CASE STUDY 6 — Intensification

The process of agricultural intensification can be observed widely in tropical Africa. This process is often spontaneous, a result of local processes and a product of local initiative. Among the Nyiha of Mbozi Area, Tanzania, a combination of population growth, alienation of land to European coffee estates, and the diffusion of small-holder coffee production all resulted in the 1950s and 1960s in a local process of agricultural intensification in food crop enterprises.

Traditionally, the Nyiha used a variety of shifting cultivation techniques in the indigenous miombo woodland, with a number of crop sequences being followed before field abandonment. The major crops included maize, sorghum, millet, cassava, and legumes. In Mbozi there is one rainy season lasting 5-6 months with annual precipitation averaging 40-50 inches. As land alienation and allocation of land to coffee, a permanent tree crop, occurred, pressure on food crop producing resources increased. This was partially alleviated by internal migration to less densely settled areas, but the major adjustment has been to use more intensive grassland-fallow management techniques to replace shifting cultivation. Ridging and mounding, both of which utilize plan material and crop wastes, were previously used in household gardens and in limited field areas constructed at the margins of seasonally flooded areas. These techniques were applied to more extensive areas as a way of increasing the duration of land use before fallowing and of bringing grassland fallow back into production. Intercropping and relay cropping remained important in the crop sequences; true legume/grain rotations were locally developed, including incorporation of wheat as a late season cash grain. Cassava became increasingly important as a crop adapted to lands whose productivity was limited and to scarcity of labor inputs.

In addition to intensified food crop production, coffee was incorporated into the annual labor cycle, mobilizing male labor resources not typically used in most food crop enterprises. Diffusion of coffee, and of the technologies for coffee establishment, management, harvesting, and processing, was focused on the coffee estates. The estates, dispersed among smallholder farms, employed many local Nyiha on a half-day basis, allowing transfer of scaled-down techniques to smallholder coffee operations. Among the Nyiha, intensified traditional food crop production techniques coexists along with sophisticated production of coffee using fertilizers, agricultural chemicals, and 'modern' management techniques. This dual enterprise pattern is found widely in Africa as low-resource farmers produce much of their subsistence food needs, along with one or more export crops.

Critical needs for this kind of dual agricultural system to thrive include enhancement of the intensificatio process, coordination of labor needs among food and cash crop enterprises, appropriate allocation of land resources, and a commitment to the importance of local food production as a risk-minimization strategy (Knight, 1974).

Child

CASE STUDY NUMBER 1

Rendilli Development Project

The problem of degradation of the arid lands of northern Kenya is a serious one that needs urgent attention. In 1976 UNESCO Integrated Project on Arid Lands began funding an on going research program that centered on the lands occupied by the Rendilli people called "Combating Desertification and Rehabilitating Degraded Production Systems in Northern Kenya". After five years of total production system research they concluded that the natural ecosystem is not always the most efficient in the conversion of solar radiant energy in primary production into secondary production. A manipulated system may produce more dry weight of plant material and frequently furnishes that more closely meets the requirements of consumers than does the native ecosystem.

They found that the pastoralist with his family form the pivot of his way of life. A change in the practices of pastoralism depends on the pastoralists willingness to adjust his physical, mental and spiritual attitudes - it actually amounts to o reorientation of the pastoralist as a person.

It was concluded that future development plans involving pastoralists must be integrated and inter-disciplinary and incorporate the following measures:

continue research and monitoring on the status and trends in the ecology and the social conditions of the region;

to provide an outlet for surplus livestock, greatly improve livestock marketing facilities;

as a stimulus to the economy of the region, raise the price of animal products on the markets above their present artificially low levels;

institute a co-operative livestock management system to be coordinated with settlement schemes and rural industries;

designate areas of intensive management close to settlements where the grazing of livestock will be prevented or reduced to a minimum to promote the rehabilitation of the vegetation;

where livestock concentrations occur and are likely to cause the depletion of the woodlands through boma construction, provide, as a service, artificial fencing materials;

within the cooperative livestock management scheme, appoint local qualified and experienced range management officers to regulate grazing with the agreement and participation of the herdsman;

by all means possibly, disperse the livestock populations widely across the District to reduce the impact of grazing in the settlement areas and make full use of the grazing resources available but not used because of insecurity;

in order to make it possible to use the present under-used area, greatly improve security against bandits and inter-tribal livestock raiding;

when the dispersal of livestock becomes possible, provide a system for transporting milk rapidly to the settlements from the dispersed milking herds;

introduce planned watering points to assist both in the distribution of livestock and reduce congestion in present concentrations.

Although the points raised are specific to the Rendili people in northern Kenya, they point to problems of development in all of sub-Saharan Africa. One of the keys to this project was that there was an eight year period of basic and applied multi-disciplinary research prior to the development of management plans for the area. In addition, monitoring is continuing as the management plan is implemented.

CASE STUDY NUMBER 2

Impact of the 1983/84 Drought on Cattle, Sheep and Goats in Kenya

During the 1983/84 severe drought in Kenya, Kajiado District lost 78% of its cattle herd, 59% of its sheep flock, and 50% of its goat flock. In economic terms, this loss is equivalent to 40 million US dollars. Extrapolation of these figures relusts in an economic loss of 403 million US dollars for all of Kenya, equaling 8% of Kenya's Gross Domestic Product.

Drought is a regular occurance in sub-Saharan Africa and it must be considered in development planning. Table 1. (Mukhebi etal., 1985) shows a record of major droughts in Kenya from 1836 to 1984.

The impact of drought and changing land use patterns has had a significant affect on household food. Table 2 & 3. (Mukhebi etal., 1985) shows household food before, during, and after the 1983/84 drought. Kajiado District is mostly populated by Maasai and Machakos District is mostly populated by Kamba. These two tribes have traditionally been quite different in life style. The Maasai are traditionally nomadic pastoralists and the Kamba are mixed farmers.

The two tribes live adjacent to each other and in the past have had a buffer zone inbetween their traditional land holdings. As population pressures increase they have both expanded into the land that separated them in the past. This marginal land is not as suitable for the growing of crops such as maize as is the land traditionally occupied by the Kamba tribe, but is planted by both tribes. In addition the Kamba have expanded their livestock holdings. The cultivation of marginal land is increasing here and throughout Africa and will likely continue to increase in the future. This trend presents a major research and development challenge.

Table 1. Mr. J. K. Kimanga's Historical Record of Droughts in Kenya, 1836 - 1984.

Year of Drought	Kikamba Explanation	English Translation[1]
1836	Yua ya ngovo	Lending and borrowing from neighbours.
1850	Yua ya kiasa	Long famine (lasted for long time).
1861	Yua ya mutulungo	Mixture of Baobab flour and flour provided by colonialists as major source of food.
1870	Yua ya ngetele	Fruit berries (as major source of food).
1880	Yua ya ndata	Star (People believed that the famine was caused by a fallen star).
1890	Yua ya muvunga	Rice (as major source of food).
1910	Yua ya maalakwe	Beans (as source of food).
1916	Yua ya ndungu	Smallpox (epidemic).
1920	Yua ya imili ya isuku	Chloera (outbreak of mental derangement).
1929/30	Yua ya kakuti/ngalukangye	Staying helplessly (waiting for famine relief).
1934	Yua ya mavindi	Bones (selling animal bones for cash to buy food).
1950	Yua ya makonge	Sisal (selling sisal for cash to buy food).
1961	Yua ya ndeue	Aeroplane (dropping of famine relief food from planes due to severe floods).
1980	Yua ya nikw'a ngwete	Money (people had money but no food to buy).
1984	Yua ya nyeki	Forage (searching for livestock forage).

[1] Translation by Mr. Rueben M. Mulwa, Headmaster, Mwailu Primary School, Box 12, Makindu.

Table 20. Main Types and Sources of Household Food Before, During and After the 1983/84 Drought in Kajiado District, Kenya, 1985.

Food Type	Pre-Drought						During Drought						Post-Drought						Total Period					
	Ranch	Market	Famine Relief	Total N = 67 No.	%	Rank	Ranch	Market	Famine Relief	Total N = 67 No.	%	Rank	Ranch	Market	Famine Relief	Total N = 67 No.	%	Rank	Ranch	Market	Famine Relief	Total N=67x3=201 No.	%	Rank
Ugali	7	52	0	59	88	2	5	61	0	66	99	1	7	50	3	60	90	1	19	163	3	185	92	1
Maize	11	9	0	20	30	5	8	10	3	21	31	5	9	6	22	37	55	4	28	25	25	78	39	5
Beans	11	8	0	19	28	6	9	13	0	22	33	4	11	12	3	26	39	5	31	33	3	67	33	6
Meat	47	0	0	47	70	3	14	16	0	30	45	3	22	18	0	40	60	3	83	34	0	117	58	2
Milk	62	0	0	62	93	1	3	7	0	10	15	8	25	0	0	25	37	6	90	7	0	97	48	4
Vegetables including Potatoes	3	19	0	22	33	4	2	43	0	45	67	2	6	40	0	46	69	2	11	102	0	113	56	3
Rice	0	15	0	15	22	7	0	17	0	17	25	6	0	11	0	11	16	7	0	43	0	43	21	7
Wheat Flour including Bread	0	7	0	7	10	8	0	5	0	5	7	9	0	7	0	7	10	9	0	19	0	19	9	9
Tea including Sugar	0	4	0	4	6	9	0	13	0	13	19	7	0	8	0	8	12	8	0	25	0	25	12	8
Fruits	0	0	0	0	0	--	1	1	0	2	3	11	1	0	0	1	1	11	2	1	0	3	1	11
Fats	2	0	0	2	3	10	0	4	0	4	6	10	0	2	0	2	3	10	2	6	0	8	4	10
Bananas	0	1	0	1	1	11	0	0	0	0	0	--	0	0	0	0	0	--	0	1	0	1	0.0	--
Blood	0	0	0	0	0	--	1	0	0	1	1	12	0	0	0	0	0	--	1	0	0	1	0.0	--

Table 3. Main Types and Sources of Household Food Before, During and After the 1983/84 Drought in S. Machakos District, Kenya, 1985.

Food Type	Pre-Drought						During Drought						Post-Drought						Total Period					
				Total N = 106						Total N = 106						Total N = 106						Total N=106x3=318		
	Farm	Market	Famine Relief	No.	%	Rank	Farm	Market	Famine Relief	No.	%	Rank	Farm	Market	Famine Relief	No.	%	Rank	Farm	Market	Famine Relief	No.	%	Rank
Ugali	10	3	0	13	12	15	1	53	0	54	51	5	10	4	0	14	13	12	21	60	0	81	25	9
Maize	106	0	0	106	100	1	3	85	16	104	98	1	93	3	10	106	100	1	202	88	26	316	99	1
Beans	85	10	0	95	90	3	8	47	0	55	52	4	50	13	1	64	60	3	143	70	1	214	67	3
Meat	38	51	0	89	84	4	17	43	0	60	57	3	19	40	0	59	56	5	74	134	0	208	65	4
Milk	73	9	0	82	77	5	19	24	0	43	41	7	42	13	1	55	52	6	134	46	1	181	57	5
Vegetables	24	27	0	51	48	6	10	52	0	62	58	2	40	23	0	63	59	4	74	102	0	176	55	6
Potatoes	11	0	0	11	10	16	1	11	0	12	11	12	12	5	0	17	16	10	24	17	0	41	13	14
Rice	0	16	0	16	15	12	0	40	0	40	38	8	0	8	0	8	8	15	0	64	0	64	20	11
Wheat Flour including Bread	0	20	0	20	19	10	0	48	0	48	45	6	0	10	0	10	9	14	0	78	0	78	25	9
Millet	27	0	0	27	25	9	1	0	0	1	1	15	15	0	0	15	14	11	43	0	0	43	14	12
Sorghum	19	0	0	19	18	11	1	2	0	3	3	13	22	2	0	24	23	8	42	4	0	46	14	12
Green Grains	14	0	0	14	13	14	0	1	0	1	1	15	11	1	0	12	11	13	25	2	0	27	8	15
Peas	101	3	0	104	98	2	12	18	0	30	28	10	102	3	0	105	99	2	25	24	0	239	75	2
Cassava	15	0	0	15	14	13	1	1	0	2	2	14	7	0	0	7	7	16	23	1	0	24	8	15
Fruits	0	1	0	1	1	18	0	0	0	0	--	--	1	1	0	2	2	18	1	2	0	3	1	18
Bananas	9	0	0	9	8	17	2	0	0	2	2	14	4	2	0	6	6	17	15	2	0	17	5	17
Tea including Sugar	0	30	0	30	28	8	0	36	0	36	34	9	0	30	0	30	23	8	0	96	0	96	30	7
Cooking Fat	11	28	0	39	37	7	0	18	0	18	17	11	4	21	1	26	25	7	15	67	1	83	26	8

CASE STUDY NUMBER 3

Rural Development: The Maasi Range Development Project

The Maasai Range Management and Livestock Improvement Project operated in northern Tanzania for ten years (1970 to 1980) and was funded by USAID. A review of the project by Jon Moris indicates that USAID showed an awareness that it requires substantial time to improve traditional pastoralism. He also felt that the project erroneously displayed a high level of confidence in western range management technology. Moris concludes with five lessons this project illustrates for rural development programs generally.

First, it illustrates the chasm which commonly lies between the "ought" and the "can" — between the desirable and the feasible. Economists writing about development often assume analysis is complete when substantive requisites are identified. One frequently reads statements like: "a ten percent annual offtake must be maintained..."; "adequate and timely price information is essential...". Statements in an imperative and prescriptive vein intimate that the means to action exist. He suggests that the means are often the primary problem. This project suggests the importance of modifying prescriptions to fit capabilities in the short run and not vice versa.

Second, any project or program which must work against the grain of inherent trends must be seen as being endangered. There is an invasion of pastoral lands by marginal crop cultivators being pushed outwards by population pressure. The cultivation is fiercely risky, but the returns per hectare to individuals exceed those from pure pastoralism. Short run, high risk exploitive farming continues to displace pastoralists from the best rangelands, which formerly supported livestock during dry seasons and are consequently the key to the productivity of the pastoral system.

Third, the pastoral dilemma is fundamentally a systems problem. No single measure is likely to change things greatly because of the negative influence of other weaknesses in the total rural system. Modernization of pastoralism remains a theoretically attractive possibility, but it requires simultaneous improvement in seven areas:

Control over land use.

Developing alternate food supplies.

Finding ways to identify individual animals.

Means to keep foundation herds alive during extreme drought.

Adequate disease control to lower risks of production.

The linkage of defined human and stock populations to particular ranches for which the people feel responciple.

Efficient transport and marketing of animals without high death loses so that attractive prices can be offered.

Unless we can learn to improve the interagency matrix of services in a coordinated fashion (integrated rural development), individual project investments will remain relatively ineffective. It does seem that many other types of rural development share this dilemma.

Fourth, high risk projects should include fall-back objectives which convey substantial benefits even if the primary objectives are not realized. In the Maasai Project a speacial effort was made to Maasai students into livestock training. It was the hope that the project would leave behind a sufficient logistic and human capital base so that, even without technical experts, the region could achieve its own solutions for the pastoral population.

Fifth, the retention of residual and fall back benefits becomes much less likely when major programs are implemented under a project framework. Projects are time-phased. In the Maasai project there was no operational base where resources could be lodged that might survive the project itself. Once the project funding ended the better staff were transferred to other regions (often at their own initiative); the many reports, maps, etc. that had accumulated were dispersed; and the entire fabric of what had been a large program fell into pieces. Yet for a while the project sufficient resources to begin solving the major field problems one by one. In Moris' view this underscores the need to institutionalize program resources separately from individual projects, so that over the longer run a government can learn from its own past experience in each of the major domains for rural development.

APPLICATION OF PRINCIPLES (goal: 5pp)

For the goals of development to be achieved within the concepts and principles for natural resource management, there are significant challenges and opportunities for development assistance organizations. In this brief discussion, these challenges and opportunities are organized at the research, project design, project implementation, and project evaluation phases. Much of the vast literature on environmental impact analysis is applicable (eg. World Bank, 1974) as are models and standards for assessing environmental quality

Research

1. Design of mechanization consonant with available energy resources and with maintaining the ecological benefits of field systems based on techniques other than monocropping.

2. Development of multiobjective models for research and planning which recognize:

    2a. The multiple objectives of farming units (Flinn, Jayasuriya, and Knight, 1980), rather than the single objective--profit maximization--used in modelling U.S. farms and enterprises;

    2b. Incorporation of environmental as well as social and economic objectives as a single systems model (Ridgley, 1985);

    2c. Achievement of a stable, sustainable subsistence food supply yet identify opportunities for innovation and limited risk-taking.

3. Rationalizing and improving traditional practices in scientific terms, paralleling the research that has already been accomplished pointing to the rationality of practices such as intercropping (ASA, 1976; Greenland and Lal, 1977; Igbozurike, 1971, 1977, 1978; Ohm and Nagy, 1985; Okigbo and Greenland, 1976; Steiner, 1984; Richards, 1985).

4. Research on methods for application of advanced methods of environmental assessment and modelling:

    4a. High resolution remote sensing for ecological mapping, including plant communities, soil water resources, geological structure, extent of flooding, and similar phenomena.

    4b. Establishment of techniques for ecological characterization of both potential "natural" conditions and disturbed ecosystems (Adejuwon, 1976).

4c. Modelling of ecological systems, such as identification of critical land management areas in watersheds, soil erosion potentials, etc.

4d. Ecological and energetic modelling of farming systems and enterprises.

5. Definition of areas which are agro-climatically and agro-ecologically analogous at a micro- as well as meso- (regional) scale (FAO, 1978).

5a. Definition and mapping of analogous areas;

5b. Establishing programs for trials of traditional and new technologies in geographically separate but environmentally analogous areas.

6. Development of advanced techniques for the documentation and preservation of traditional agricultural systems and knowledge:

6a. Preservation and experimentation on genetic material;

6b. Preservation of traditional agricultural knowledge (Richards, 1985).

7. Continuing research on human and livestock diseases which are primary limiting factors for utilization and development of major ecological zones in Africa:

7a. Floodplains and irrigated areas: river blindness, schistosomiasis, etc.

7b. Woodland and forest zones: arboviruses, trypanosomiasis

7c. Grassland/savanna areas: tick-borne diseases, trypanosomiasis

8. Development of a unifying methodology for assessing the environmental dimensions of development projects for comparative and analytical purposes.

Project Design

1. Climatic and ecological documentation for the target area, including specification of levels of uncertainty in data as well as variation around means (Conant, *et al.*, 1983).

2. Ecological analysis of existing practices in the target area in terms of the goals for natural resource management.

3. Development of guidelines for the selection of technologies available from agro-climatically and agro-ecologically analogous

areas for potential evaluation and implementation.

4. Participation on scientific as well as social and economic issues by the target population.

5. Determination of appropriate environmental indicators for on-going assessment of project impacts (stream runoff, sediment load, soil erosion, wildlife populations, soil microorganisms, etc.

6. Establish environmental standards and tolerances as project goals along with economic and social goals.

Project Implementation

1. Establish monitorring systems for environmental indicators.

2. Link on-going measurements to models previously established to develop an early-warning system for mitigating environmental degradation.

3. Maintain a flow of information about innovations as well as field trials to assess technologies for environmental as well as social and economic suitability. Networks such as that established by VITA (1970) should be utilized.

4. Utilize appropriate technologies and local resources to meet wider human needs, and, in particular, trace the flow of materials and impacts that link environmental resources, agricultural products (plus by-products and wastes) and human needs in assessing alternative solutions to identified problems.

Project Evaluation

1. Assess the project not only in terms of economic and social indicators, but also in terms of environmental impacts and indicators.

2. Widely disseminate not only results of successful projects but also of successful practices and of failures at the project and practice level (Farvar and Milton, 1972).

3. Measure the project against standards and tolerances established both at the scientific level and for assessment of the specific project. Use results as feedback to the project design and implementation processes.

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KNIGHT Draft BRIEF DISCUSSION (4a)

GOALS OF DEVELOPMENT VS. PRINCIPLES AND CONCEPTS (goal: 5pp)

The identified goals of development in this project are listed as:

(1) to increase people's quality of life;
(2) to reduce vulnerability;
(3) to maintain, build upon, and improve indigenous resources and systems;
(4) to ensure economic and environmental sustainability;
(5) to improve the quantity and quality of agricultural production; and
(6) to remove or reduce production, marketing, storage, and processing bottlenecks.

These goals are in many ways similar to those proposed by the ENDA (Environmental Development Action in the Third World) organization in Dakar for "Environmental Development" in Africa (UNEP, 1981, pp.50-59). In a short monograph produced for UNEP, ENDA suggests three scenarios for African development. The scenarios are designated to explore how a development path might be chosen to "upgrade the living conditions and environment of the African people as a whole" and to "permit a considerable improvement in the lot of the poorest two-fifths of the African population" (UNEP, 1981, p.32).

The three scenarios developed by ENDA are (1) Dependent Growth and Environmental Misuse; (2) Greater Economic Autonomy, More Attention to Environmental Considerations; and (3) Environmental Development. The first scenario assumes continuation of present trends of the world economy driving African development, with continued exploitation of Africa as a source of primary products, with a continued process of environmental degradation. The second scenario suggests greater African autonomy in development, conditioned on redistribution of oil revenues in Africa, increased cooperation, redistribution of revenues from growth, and a commitment to environmental conservation (UNEP, 1981, p.40). The final scenario focuses on development that is locally driven, a goal of self-sufficiency, and greater attention to regional potentials and problems.

The goals of Environmental Development are to benefit the maximum number of people based on:

(1) Needs as locally defined;
(2) Culture evolving under its own momentum;
(3) Minimizing external exploitation;
(4) Use of local environmental resources;
(5) Local decisions and innovations (UNEP, 1981, p.50).

ENDA's perspective suggests that the kinds of goals outlined in the OTA conception of development would have greatest probability of achievement within the context of Environmental Development.

These same directions are implicit in the Lagos Plan of Action and in various expressions of the basic goods economy. A similar concept has been expressed by Yapa, in his South Asian-based notion of the "ecopolitical economy" (Yapa, 1979, 1980).

Sources of technologies for African development, according to ENDA, are:

(1) Traditional African technology, based on local groups and their interactions with the local environment;

(2) Technologies created through local initiative, worked out locally in the contemporary time frame;

(3) "Old" technologies of the industrial world appropriate to the higher labor availability of Africa and to small and medium-scale enterprises;

(4) Modern technology carefully screened in terms of local, regional, and national needs.

Critical to Environmental Development is a reassessment of traditional technologies as a source for innovation both locally and in other areas of Africa. Local resources, technologies, and environmental management are seen as a basis for change, rather than the elements to be replaced by development.

There is increasing recognition that the kinds of development trajectory outlined in ENDA's first and second scenarios are failing to achieve the goals outlined by OTA. Eicher, an agricultural economist with significant Third World development experience, has recently argued that agricultural development must be seen as evolutionary, based on traditional peasant-scale farming activities, rather than an expectation that some miraculous breakthrough will result in revolutionary change (Eicher, 1986). Vermeer, a geographer with experience in West Africa, argues similarly that traditional agriculture will be the basis for change in developing areas (Vermeer, 1982, 1983). Lofchie and Commins, political scientist and African food project director, point to a "morass of historical, environmental, and economic factors...so complex as to render the efficacy of any solution [to the African food crisis] problematic" (Lofchie and Commins, 1982, p.22). They suggest that guidelines for agricultural development include political empowerment of the peasants, policies to prevent development of a rural landless class, freer access to world commodity markets, and technologies sensitive to environmental constraints and sustainability (Lofchie and Commins, 1982, pp.24-25). Richards, also a geographer, has spoken eloquently to the value of traditional technologies in addressing the environmental exigencies of Africa (Richards, 1983). In a recent book, Richards argues that "local agricultural skills [in West Africa] are underutilized but potentially profitable resources for agricultural development" (Richards, 1985, p.159). The

World Bank has also acknowledged the crucial role of smallholder agriculture (World Bank, 1981, pp.50-54). The emergence of this new 'paradigm' for agricultural development in Africa in the 1980s can be traced to much earlier work that explored African traditional agriculture in relation to African ecology (Trapnell, 1943; Allan, 1965). Through the 1960s and 1970s, there was increasing recognition of the viability of traditional land management systems, within important environmental and socio-economic bounds (eg. Knight, 1974). Finally, in the 1980s, we look back on nearly two decades of post-colonial development experience that has seen a general decline in African agricultural production per capita, no discernable increase in yields of the major staple crops, and increasing food dependency, in spite of massive external aid and development project initiation (USDA, 1981; US.OTA, 1985). "Environmental Development," in ENDA's terms, would at least focus on local self-sufficiency and decreased rather than increased vulnerability in rural Africa.

Major conflicts that will arise as the concept of Environmental Development is implemented include:

(1) The relatively modest levels of economic achievement likely in rural areas in comparison to both expectations and to levels of apparent income in the urban-industrial sector;

(2) Whether Environmental Development is seen in Africa more as externally inspired environmental conservation and preservation motivated by global environmental concerns in the industrial nations versus a genuine, informed commitment to an increased quality of life in Africa;

(3) The disparity between the scale of resolution required to effectively assist in development in local communities and ecological systems versus the scale of activity of donor nations and agencies. The kinds of activity described and appropriate for development assistance are very much micro-scale in spatial extent. We must now recognize that a major element of macro-scale development policy will be to support strategies that permit meso- and micro-scale decentralization of development assistance;

(4) The degree to which technologies are scale-dependent or scale independent. Technologies are seldom neutral in relation to the economic or social status of potential recipients, nor to the scale of the agricultural system in use.

(5) The degree to which technological change promising greater output requires external inputs and/or a narrow range of environmental conditions, both of

which establish a vulnerability exceeding that before 'development.' Some observers now argue that apparently 'natural' hazards or disasters must be seen as environmental events impinging on human communities placed in a position of vulnerability by historical, economic, and political processes (Hewitt, 1983).

(6) Developing means of communicating effective technologies across ethnic and national boundaries, so that achievements in one agro-climatic/agro-ecological milieu can be disseminated to similar areas elsewhere in Africa. ENDA and its journal *African Environment* have made important strides in this direction.

(7) "We," the Western scientific community, have much to learn about the African environment and ecological processes in the tropics. Local environmental and ethno-scientific information can inform "us," but much needs to be done to develop effective cross-cultural scientific communication (Brokensha, Warren, and Werner, 1980; Knight, 1980; Richards, 1985).

(8) Many of the environmental principles are admirably addressed in traditional African agricultural systems. Richards has suggested that "intercropping...is one of the great glories of African science" (Richards, 1983, p.27). The characteristics of such effective technologies that make them environmentally attractive also make them less amenable to mechanization or use of draft animals. Thus the goal of removing labor bottlenecks in field crop enterprises may conflict with goals to conserve soil and water resources and to maximize use of solar radiation.

(9) African nations are diverse in the productivity potentials of their resource base and in the availability of non-agricultural resources for development. Petroleum-producing Africa nations may more appropriately use energy-subsidized technologies than petroleum-importing mations. The availability of petroleum or other non-agricultural wealth will make the "appropriate technology" approach of Environmental Development less attractive, although this may still be the only viable alternative for the poorer rural areas of apparently wealthier African nations.

(10) 'Wild' sources of plants and animals are still important in Africa. Wild animals supply bush meat. Fruit bats help control insects; snakes control rodents. 'Wild' plants provide fuelwood, medicinal commodities, building materials, and dietary inputs. As development brings an increasing proportion of the

land into production, there must be recognition of means to supply the former contribution of these 'wild,' free services of nature.

(11) Finally, issues of sustainability and reliance on local resources and biological processes may imply lower levels of productivity and returns to labor than are achieved in heavily energy-subsidized industrial agriculture (Pimentel, 1980; Leach, 1976; Bayliss-Smith, 1982). In addition, the reality of photosynthetic processes means that tropical lowlands have lower agricultural potential (related to day length, temperature, and radiation intensity —cloudiness) than middle latitude areas (Chang, 1968, 1970). Thus modest gains in productivity will be locally important. These gains should be measured against local needs rather than against an arbitrary notion that yields comparable to the U.S. (ignorring sources of energy subsidy, environmental conditions, and negative externalities--pollution) are the measure of success.

(end)

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Appendix 1

KNIGHT REVISIONS ITEM 1

HIGH TECH/LOW TECH: ISSUES IN LOW RESOURCE AFRICAN AGRICULTURE

We have no good definition of 'high technology.' Therefore, let us assume by this we mean advanced use of materials, energy, and products that cannot be developed in the village setting. Among critical issues in the use of high tech elements in evolving African agricultural systems, then, are:

1. **Degree to which the technology can be locally sustained.** As an example, hybrid crop varieties depend on seed producing institutions; composite varieties can be locally sustained. Mechanized implements may not be locally produced, but should be amenable to village level maintenance, perhaps to the overhaul level.

2. **Dependency on external sources of energy.** For example, technologies based on large-scale mechanization may depend on imported fossil fuels. No-till planting depends on use and availability of herbicides.

3. **Degree to which the technology can be understood and used safely.** For example, agro-chemicals require thorough training and care for both human and environmental protection.

4. **Appropriateness of the technology for the required task.** For example, clearing can be facilitated by mechanization; the cost may be much greater levels of runoff and soil erosion compared to traditional methods of clearing. Environmental knowledge can be gained from satellites and expensive image processing facilities, using highly trained technologists. It can also be gathered in the field at a scale appropriate to local planning, using local personnel.

5. The degree to which African societies as donors remain participants in the technology. Here, I think specifically of genetic engineering/crop breeding, etc. using indigenous African plants and varieties. Would African nations and farmers be forced to 'buy back' innovations based, in fact, on genetic material exploited from their own environment?

6. The degree to which the technology increases rather than decreases vulnerability to risk and uncertainty. Irrigation based on limited water resources, for example, may not be possible in drier years. Deep boreholes may help in herd maintenance during the dry season, but can encourage stocking levels that are disastrous in drought periods.

DEVELOPMENT ASSISTANCE BASED IN INDIGENOUS TECHNOLOGY

Indigenous knowledge and practices are an important point of departure for agricultural development in Africa. The fine spatial 'grain' of African ethnic groups and agricultural systems would seem to preclude the possibility of manageable assistance that could interact at that scale of resolution. Nevertheless, there do seem to be some important initiatives that are possible:

1. **Integrated natural resource/agricultural system mapping.** On-going activities involving mapping of soils, geology, and ecological systems (parallel to our county soil surveys) should be parallelled by mapping of indigenous agricultural systems. Although tha tradition for doing so can be traced back for over a quarter century (Trapnell and Clothier, 1957), there is no consistent pattern of environmental, land use, and agricultural system mapping. Such a program could be a major contribution to development planning and resource assessment.

2. **Development of field survey methodologies for the documentation, modelling, and assessment of agricultural systems.** This is again parallelled in our own farm budget survey methods used for assessing farm operations.

3. **Interdisciplinary and interregional workshops on development of indigenous agricultural systems.** Such workshops would serve a number of important purposes, including enhancing the awareness of indigenous technologies among development officials, developing an international research agenda, sharing information across common ecological zones represented in

different nations, developing plans for research on and disemination of technological developments, etc.

4. **Training programs for American and indigenous participants in development projects.** Such training programs would both sensitize technical staff on issues of local agricultural initiative and provide information on in-field research and planning techniques.

5. **Integrated development projects based on ecological zones across national boundaries, hierarchically structured to recognize specific national settings as well as local ethnic environments.** Such projects could focus on specific common issues in similar environments, with a specific purpose of enhancing the flow of information across traditional and contemporary boundaries.

6. **Enhanced research on indigenous crop species and varieties.** Develop institutions and field stations focused on the collection, investigation, and breeding of varietals that could hold promise for increased productivity. This could be accomplished through some existing institutions in both donor and recipient nations, on a cooperative basis.

7. **Strengthening agricultural research and extension in the African nations.**

8. **Strengthening agricultural education and training.** Both 7 and 8 could be based on a mandated focus on indigenous technologies and their improvement.

9. **Development of strict guidelines limiting project focus on imported technologies unless a prior documentation and**

analysis of indigenous systems and their relationship to the proposed technologies have been documented.

10. Development and support of an information service for the dissemination of information and research on indigenous technologies.

PRINCIPLES & CONCEPTS IN REFERENCE TO TRADEOFFS

The question raised was how our principles and concepts could guide the selection among alternative actions for development. In response, I refer to our cooperative list of principles (paragraphs 1-15). First, I would urge review of the document on Application of Principles (paragraphs 384-405), which discusses some ways in which the principles can be operationalized. Specifically, some of the items cited deal with handling issues of tradeoffs:

1. Research
    - Mechanization vs. availability of energy sources
    - Multiobjective models, which inherently deal with tradeoffs
    - Rationalizing of traditional agricultural practices in scientific terms
2. Project design
    - Dealing with uncertainty around environmental norms
    - Technological assessment and choice

Turning to the general question raised, it would seem that the following guidelines could be particularly helpful in making tradeoffs (numbers refer to paragraph numbers):

1. Integrated systems--implies that new technologies or enhancement of existing technologies should be evaluated in terms of impact on other system aspects, eg. labor input.

4. Sustainability and risk--implies that technologies and strategies should aim for more than rapid economic return in a fixed or uncertain time-frame.

REACTIONS TO COMMENTARY

Several issues identified in the review commentary were singled out for specific reaction. A response follows:

1. Population growth and its effects largely ignorred:

Part of the problem here is the revision done by Child on the original document B1b, Commentary on Principles. You may find it helpful to refer to p.3, principle 4. Part of this was captured by Child in para. 7 of the revised document. Similarly, principle 9 (p.5) on my original refers to intensification; this material is included as para. 95. Para.166ff also discuss the technologies in view of population changes. It might be possible to elevate the population element to a more explicit level. Integrated principle list item C could have a specific sub-principle:

- o Development assistance should focus on technologies which will enable increases in local productivity in the face of significant population growth

Finally, it seems to me that issues of population growth are also important in terms of human and institutional systems, amd should be addressed in this context.

2. Importance of human nutrition

This is part of the overall project goals and, thus, implicit in discussion of productivity increases. Nutritional quality, however, could be addressed on the production side in the list of principles as a specific item:

3c (para.3 and 21ff): Assure adequate caloric, protein, fat, mineral, and protective elements consonant with the age, sex, and activity levels of the human population.

SPECIFIC QUERIES

Para.18: Move to just above para. 94.

Para.20-23: This is Child's concept; part of my original submission was subsumed under his observation that 'energy flows through the ecosystem.' Refer back to my original principles 1a and 17a,b. I think these probably could be subsumed under Child's omnibus category 10, Increase Productivity.

Para.24-45: These items include a number of issues related to diversity and sustainability. I believe they could be incorporated as follows:

Old para. number:	Integrated concept letter:
24	G
25-34	C
35-38	G
39-41	A
42-45	D

I think the basic problem here is the combining several of the original principles into one mixed heading (old principles number 1b, 1i, 10, 18, 21, 22, and 24).

Para.46-49: I think this section would be clearer if we went back to the original principles, item 1. Another alternative would be to reword the heading:

> 5. Recognize basic temporal, spatial, and structural constraints governing the functioning of existing agricultural systems, adapting and/or adjusting new technologies to perform within these constraints.

Para. 50-56: The problem here is including climatic for renewed activity. There are several reasons for this. First, I believe we have a moral commitment o make good on failed projects. Second, there may already be important and useful infrastructure in place (buildings, roads, etc.) which would have to be duplicated elsewhere. Finally, we should force ourselves to recognize previous mistakes, learn from them, and test our diagnoses by setting them right. Move para. 92 to just after para. 38, which deals with resource commitments. It just doesn't fit very well here.

Para.117: Revise to clarify:

c. Through use of chemical supplements, fallowing, crop rotation, and similar nutrient-enhancing strategies, assure adequate nutrients for yield maximization.

Para.126: Revise as follows:

d. Prevent excessive waterlogging during the season of greatest rainfall through use of mounding, ridging, and drainage strategies to raise crops above waterlogged soil levels and/or to enhance removal of excessive water.

KNIGHT REVISIONS ITEM 6

KEY PRACTICES: INSTITUTIONS AND CONSTRAINTS

1. Intercropping

Institutional Aspects

Intercropping research has been done in Africa for a half century (Kenya). However, there is much more to be learned about the impacts and potentials of intercropping as a major technical strategy, particularly in the face of marginal labor availability, mechanization, and use of agricultural chemicals. Major institutional contributions to intercropping could come from:

Crop breeding

Documentation of intercropping systems and systematic evaluation of them

Dissemination of intercropping technologies from source areas to potential recipients, after assessment and evaluation

Collection and evaluation of indigenous crop species and varieties

Training for agricultural education and extension based on intercropping research

Constraints

Western bias toward monocropping systems

Limits on use of conventional mechanization strategies

Uncertain impacts of agri-chemical use; severe limitations use of herbicides which could negatively affect co-crops

Inadequate understanding of monocrop systems in comparable environments for comparable crops; Beckerman (1983) points to more common use of mon- vs. intercropping in some South American agricultural systems. Why this occurs is uncertain. Is intercropping a primarily African innovation?

(constraints, continued)

Availability of parts and skills on a local scale to sustain mechanization

Foreign exchange for petroleum resources

3. Pump Irrigation

There is considerable experience from the American Plains and West in pump irrigation. Thus it should not be surprising that significant attention is being devoted to pump irrigation as a technology for savanna areas of Africa.

Institutional Aspects

Institutions can play a major role in the development and dissemination of pump irrigation, but there are significant issues in fostering this technology. On the positive side, institutions can:

Sponsor research programs on the application of pump irrigation in African savanna areas

Crop breeding for optimum irrigation performance

Provide credit/grants for wells and pumps

Project planning for irrigation development

Development of pump technologies using local energy sources, such as solar energy (at the present not technically or economically feasible for non-domestic water pumping, and questionable even in this case)

Resource assessment for irrigation projects, including ground water hydrology investigations, soil mapping, agronomic modelling

Constraints

Energy availability

Extent of water resources in time and space

Need for greater scientific understanding of the mechanisms associated with excessive soak-in and landslides in high-risk areas

Credit availability

Benefits of alternative technologies for increasing yields--fertilizers, herbicides, mechanization

5. Use of chemical fertilizers

Chemical fertilizers have made a major contribution to crop yields in western agriculture, although negative environmental impacts have been noted--nitrogen contamination of surface and ground water, for example. Also, marginal returns to fertilizer use have decreased as higher quantities have been used. In Africa, however, fertilizer use could have a major impact.

Institutional Aspects

Research on fertilizer technology, agronomy, economics

Crop breeding and selection for fertilizer response

Training and extension

Supply systems

Credit

Research on tradeoffs with green manuring, rotations, and other locally 'appropriate' technologies

Constraints

Costs--fertilizer production and distribution

Reliability and sustainability

Impact on risk and uncertainty

Vulnerability of local community to supply disruption

GENERALIZABILITY/REPLICABILITY OF CASE STUDIES

1. Intercropping

Replicability

This practice is very widespread in Africa. A number of authors (Igbozurike, Richards, Steiner, Lagemann) have suggested that intercropping become a major focus for research and extension in Africa. Field studies at research institutions such as IITA are continuing, focusing on such aspects as row intercropping which may be more amenable to mechanization. Such research and the training/extension from it should be widely replicable, in concept if not in specific crops and methodologies.

Generalizability

We certainly cannot claim intercropping as an African panacea, and should guard against such an implication. Intercropping will be morelimited in potential in the semi-arid and savanna zones, and most relevant in the humid forest areas.

2. Indigenous Pest Control

Replicability

The concepts discussed by Richards are not widely recognized nor part of the research agenda of major research institutions. There are, however, widespread concerns about biological pest management which is closely related to Richards's notions. My guess is that the concept has wide relevance, but that specific research foci must be developed within the entomological and

4. Tie Ridges and Terracing

Replicability

These techniques already occur widely and are highly applicable in a variety of environmental settings. Again, one must avoid the implication of a panacea, but these concepts should play a larger role in the research and extension agenda. Highly replicable.

Generalizability

Ridging and terracing are most important on sloping lands and in areas where water management is critical--either to enhance soil moisture recharge or to deal with waterlogging. The basic concept is generally valid, however, but nuances related to specific soil types and crop varieties offer much potential for investigation and dissemination of approaches.

5. Mechanized Land Preparation

Replicability

The negative impacts of mechanized clearing documented in Case 5 are probably replicable in many, but probably not most African environments. Contributing factors will be land slope, soil character, rainfall regime, and kind of mechanization. Nevertheless, the risk associated with replacement of manual clearing vs. mechanization should be recognized and evaluated before mechanization is selected as appropriate for a given area or project.

Item 8 was forwarded previously

KNIGHT REVISIONS ITEM 9

In addition to the attached document which indicates the principles associated with each item on the integrated list, please note the following from ITEMs 4 and 5:

ITEM 4: page 1: add sub-principle to C

page 2: add I to the integrated list of principles

ITEM 5: page 1: note rewording of principle 5 (Knight & Child)

page 2: note revision of principle 6 (Knight & Child)

page 2: note revision of principles 3,8, and 10 (K&C)

F. African women play a key role in low-resource agriculture.

- Determining the effects of policies and technologies by gender warrants special consideration.

21, 25, 28

G. Many African agricultural systems are not managed for environmental, social, institutional, and financial sustainability.

- Donors, national governments, and low-resource agriculturalists should manage these systems sustainably in order to preserve future options.

4, 7, 8, 14, 23

H. Local participation enhances the use of local resources and can help to prevent the failure of development assistance.

- Therefore it should be an integral factor in the initiation, design, implementation, monitoring, and evaluation of development assistance work.

15, 17, 22, 27, 40, 41

19: Beyond this project, at least as stated.

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Appendix 2

AUG 04 1986

RESPONSE TO REVIEWERS COMMENTS ON THE OTA PAPER
by
R. Dennis Child

1- Importance of monitoring (1 page) - Natural resource development and management in sub-Saharan Africa is a continuous process. In our integration workshop one of the main points made was that development was an incremental process. Assessment and monitoring are essential in the process of planning and implementing new interventions. They guide this perpetual redesign, redirection, and creative improvisation until the goals and objectives are achieved.

Large development schemes that attempt to leap forward rarely have succeeded in the long run, although in the short run they have absorbed huge amounts of money and human resources and give impressions of success. Development activities frequently produce unanticipated results -- economically, socially, and environmentally -- that often have far reaching negative impacts. If planners and managers had thought more about assessment and monitoring, some of the negative impacts of development might have been avoided. On the other hand, some activities thought to have been failures in the short run may have been successes in the long run. Without adequate assessment and monitoring neither short- nor long-term success can be determined.

Greater detail in methods and implications of assessment and monitoring for development planning and implementation can be found in Conant et al. (1983) and Child et al. (1984).

Guidelines for including assessment and monitoring in development assistance activities are found in Child et al. (1986 at press).

One of the problems with assessment projects is that they have not been linked to the planning of specific programs and projects. They tend to be projects in and of themselves.

Managerial monitoring has largely been limited to the intermittent progress reviews. Ecosystem monitoring, which charts the impacts of a project on the resource, the human recipients and the economy, has often been entirely omitted.

Ecosystem monitoring can include remote sensing (along with ground truth), field inventories or a combination. See Child et al. (1984 & 1986) for a discussion of documentation centers and their role in assessment, monitoring and development.

The costs of ecosystem monitoring can be quite high, in part because the risk of overkill is high. The costs of assessment and monitoring must be balanced against the cost of not achieving project goals or creating avoidable but otherwise unforseen negative impacts. What is the cost of project failure? or What is the cost of eliminating the traditional livelihood of the people within the project area? or What is the value of knowing the causes of success and failure in past development activities while in the planning process for a new project?

2 - Livestock and sedentary agriculture merging - Throughout Sub-Saharan Africa there exists a continuum of differing production systems being used on the arid and semiarid lands. They usually

incorporate some combination of crop and animal production. However, at the extremes are the nomadic pastoralists (that only harvest livestock products) and large scale farmers in high potential areas (who only harvest crops like maize). Inbetween these two extremes lies the many combinations of crop and animal agriculture and most of the production systems used by low resource agriculturalists.

Change seems to be a key characteristic of the farming systems in Sub-Saharan Africa. Some of the traditional systems practiced by different tribes or family groups have been modified in recent years to include more diverse combinations of farming activities. The pressures of population and changing settlement and land ownership patterns have caused people to live and produce food using 1) methods not traditionally part of their culture; 2) traditional production systems and crops on land of a different land use potential; and 3) traditional production systems on smaller, more restrictive units of land.

This trend can be illustrated in one of the most traditionally pastoral areas. In the Kajiado District of Kenya, which is mostly arid and semiarid land that has been largely inhabited by Masai, the human population is estimated to have increased 118% over a 17-year period. Although the pastoral population (Masai) expanded by 47% during the 17 years, the nonpastoral (non-Masai) population increased by 72% during the same period (White and Meadows, 1981). Recent studies have also shown a marked increase in the production of maize and other crops by the Masai people.

For the most part these lands have been traditionally used by pastoralists who met the challenges of drought and other management needs by moving over extensive areas. Current trends in land use and subdivision policies severely restrict these traditional movements of livestock. Existing production systems will require modifications that give the "new" low resource agriculturalist the flexibility and stability required to meet their needs to remain at least as productive as they have in the past.

The end result of a changing agricultural base in sub-Saharan Africa is that semiarid lands are under a great deal of pressure to produce goods and services for a growing population that they have not produced in either kind or quantity in the past. Many of the existing production systems have not been adequately evaluated in terms of present and future needs and the research and development of more appropriate production systems is lacking for these lands.

Many voices have been raised to stop the plow from breaking the ground in the arid and semiarid lands. That mistakes have been made all over the world is evidenced by the growing threat of desertification. The fact is that these marginal lands are being put into crop production and are going to continue to be converted to crop production. It is time to evaluate the short- and long-term productivity and risks involved when these marginal lands are put into crop production using traditional and improved methods. It is my impression that much of the research in "farming systems" (both basic and adaptive) has focused on the higher potential lands. Future research must broaden its scope to include the systems found and appropriate for the more marginally productive lands.

It may be that one reason for the lack of research on marginal lands is the perceived lower return on the investment and lower overall productivity of these lands. As pressures on these lands continue to mount, the potential degradation and loss of productivity can be considered in the decision making process to justify increased work in this area.

3. Trade-offs between funding livestock vs. range management programs - Rangeland is a type of land that can support a number uses to meet the needs of people. Livestock grazing is one of the uses of rangeland that produes products to meet these needs and in the pure theoretical sense livestock management programs are a subset of rangeland management programs. Vegetation and soil management projects are also a subset of rangeland management programs. However, many people interchange the term range for one or more of the components of rangeland management. Your question implies that a decision for funding projects must be made between components of rangeland production systems.

The experience of past development projects has shown that projects that focus on one component of a production system have a high failure rate and often acheive negative results. For example, some projects have been focused on the veteranary services and improved animal health resulting in greater livestock numbers and overgrazing. Other projects have revegetated large areas and shortly thereafter livestock have dessemated the project because livestock management systems were not adequately developed within the existing socio-economic environment.

In summary I'm not convinced that tradeoffs exist. All production system components must be considered and priorities given to components identified as being critcle within each unique environment. The other components must be monitored along with the primary components identified by the project to insure that adequate linkages and management strategies have been established for the total production system. I would suggest that your paper stress that total systems be developed and that projects that only deal with one component be avoided or treated as a subproject within a larger program.

Sample projects to avoid when not part of a total program include: drilling wells in arid and semiarid areas, veterinary care, rangeland reseeding, brush control, livestock and crop breeding, irrigation, pest and disease control, reforestation, etc.

5. Specific revisions from the original document

para. 18 - This paragraph could fit here and/or with principle 9 (paragraphs 85-92). If forced to include it in only one place I would prefer to leave it where it is.

> Traditional African agricultural systems are adapted to the local environment. Moreover, they are organized to maximize returns to labor more than other inputs. Nevertheless, they have significant potential for improved productivity (Kowal and Kassam, 1978; De Wilde, 1967; Bunting, 1972).

para. 20-23 - The title of this concept relates to an ecological principle and not to the potential application like most of the other concept presented in our paper. Changing the title to "Make effective use of solar radiation for the benifit of humans" would solve the question posed.

> Make Effective use of solar radiation for the beneifit of humans - Plants are the primary producers in the ecosystem, converting the energy of the sun into energy usable by man and animals through the process of photosynthesis. Since energy is lost at each step in the food chain (tropic level) it is more efficient, in terms of energy use, for man to eat only plant products. However, since man cannot digest cellulose efficiently he has learned to use ruminant animals to harvest cellulose and convert it to useable proteins and charbohydrates. When animals are using forage that cannot be directly consumed by humans, the efficiency of the production system is inhanced.
>
> a. Where appropriate foster human consumption of plant products. Use animal populations to collect, concentrate, detoxify, and(or) convert resources for human use through meat, blood, eggs, or milk (Spedding, 1975)
>
> b. Ameliorate the negative relationship between solar radiation for photosynthetic activity versus adequacy and reliability of rainfall in Africa (Kowal and Kassam, 1978; Chang, 1968).
>
> > Use water management techniques to decrease risk of precipitation uncertainty.
> >
> > Use crop tolerant of rainfall shortfall or breaks in the rains.

c. Carefully assess the risks involved in using farming systems dependent on early planting or soil moisture storage to meet evapotranspiration needs after the rainy season.

Solar radiation is attenuated by the cloudiness of the rainy season; thus potential evapotranspiration is often lower during the rainy season than the beginning and end of the rains. Variability of rainfall at the change of season, combined with the high levels of potential evapotranspiration, poses significant risk to early planting. Early planting, however, allows utilization of initial nitrogen flushes in the soil, before the nitrogen is leached or extracted by weeds.

para. 24-45 - Reorganized

Management strategies must be sustainable and have minimum risk to the producer. This concept has been aptly expressed as "leaving choices for the next generations." Said in another way, natural resource management strategies must not preclude future generations from making similiar dicisions because the natural resource base is no longer capable of supporting that alternative.

a. Maintain economic, ecologic and genetic diversity while providing an optimal mix of goods and services.

b. Maintain cultural, technological, and genetic continuity.

- Human cultural knowledge
- Indigenous technologies and implements
- Seed and vegetative stocks
- Livestock populations

c. Ensure stability.

- Provide for stability by buffering sources of environmental disturbance
- Maximize the minimum conceivable yield from the system
- Ideally, agricultural systems are adapted to producing adequate food supplies in relatively poorer crop seasons. Thus the system should produce a food surplus in normal years, termed the "normal surplus" by William Allan (Allan, 1965).
- Design for yield stability over time

d. Select new technologies that do not increase vulnerability to failure under sub-optimal conditions. New technologies that offer higher return in average or better circumstances during the crop year, but threaten greater vulnerability during poorer years, may not be attractive for adoption. Thus proposed technologies should be tested against worse-than-average conditions and should be compared with existing strategies across the statisticall distribution of probable environmental conditions.

e. Enhance diversity as a major African agricultural strategy to maximize productivity and minimize risk or uncertainty. Use diversity as a major strategy to maximize returns to resource use and to minimize risk and uncertainty.

- Use various kinds of diversity, including diversity of enterprises, of spatial allocation of activity, and of temporal scheduling of activity.
- Use various crop species and varieties, as well as crop enterprises, in the farming system. A diversity of crops provides a buffer against environmental uncertainty. It also offers the advantages of a number of field systems, and it may provide the opportunity to spread labor demands over a wider period of time, decreasing labor underemployment.
- Use spatial dispersion of agricultural enterprises to increase the availability of strategies to utilize varied ecological zones and to spread risks of failure. Such dispersion, however, exacts a labor cost in travel (daily or seasonally) and may introduce other forms of risk, if dispersed enterprises cannot be monitored frequently or guarded continuously.
- Utilize the multiple ecological zones typically found across a catenary succession of soils (soil associations related to common patterns of hill top, valley slope, and valley bottom locations).
- Use hydromorphic areas for dry-season as well as enhanced wet-season production.

f. Minimize irreversible and irretrievable resource commitments; maximize future choice in resource allocation (UNEP, 1980; Brown and Wolf, 1985):

- Minimize irreversible and irretrievable commitments of resources.

- Maximize opportunities for future choice in allocation of resources that have the widest possible use (Poore, 1976, p. 9).

- Minimize negative environmental impacts of development, including water and air pollution and soil erosion (World Bank, 1974; Farvar and Milton, 1972).

g. Minimize the potential for normal ecological variation and cyclicity being converted to seculaar environmental change by human action.

  - Mitigate the risks of desertification at the arid margins of arable agriculture and of pastoral activity.

  - Prevent normal variation from becoming secular ecological change.

h. Meet needs for protective resource preservation and conservation. Recognize and allocate needs for protective resource use, such as forests, watersheds, wildlife populations, and vulnerable land (Poore, 1976, p. 12).

  - Protect "suitably large examples of natural ecosystems and of populations of plant and animal species" (Poore, 1976, p. 14).

  - Recognize the conflicting role of wildlife populations as both pests and as resources of bushmeat and other products.

  - Protect watershed catchments in regard to the quality, quantity, and periodicity of water resources (Dunne and Leopold, 1978; Miller, 1977).

para. 46-49 - Clarify (Greg's comments willbe more appropriate here)

Work within seasonal, structural and spatial constraints

a. Synchronize spatial and temporal structure in relation to seasonal fluxes of flow resources.

  - Seasonality of water supply
  - Seasonality of solar energy
  - Manage flow resources to maximize use of desirable aspects and minimize risk from undesirable phenomena (maximize use of water and solar energy; manage the flow wind to maximize beneficial aspects and minimize wind damage through crop dessication, increased evapotranspiration or wind erosion)

b. Organize space

- Territorial structure of society
- Systems of land tenure

c. Overcome the challenge of production concentrated in time and dispersed over space with consumption needs concentrated in space and continuous through time.

- Harvest production and provide storage to overcome the fact that production is concentrated in space and time in contrast to the continuous need for food in the human community whose location in geographical space is more localized in comparison to the area required for agricultural production (Knight and Wilcox, 1976; Carlstein, 1982)

para. 50-56 - Clarify, edit and shorten

Change and climatic fluctuation is to be expected in natural resource systems -

a. Recognize the dynamics of agricultural systems. Agricultural (Farming) systems are by nature dynamic through given seasons and through successive years, due to such factors as seasonal fluctuations of environmental factors and progressive or secular changes in population density, orientation to cash crops, availability of land resources, and similar factors (Knight, 1974; Kowal and Kassam, 1978; Okigbo and Greenland, 1976; Harwood, 1982; Ruthenberg, 1980).

- In general, African agricultural systems are undergoing processes of intensification. Intensification is most frequently induced by necessity (Population growth, land circumscription and land allocated to market crops). Intensive compound garden (homestead or dooryard garden) techniques should be extended to more extensive enterprises (Okigbo and Greenland, 1976; FAO, 1983).

c. Maximize productivity by articulation of agricultural activities in relation to the annual climatic calendar. Farming systems exhibit seasonal cycles of behavior involving fluxes of energy, water, and human activity in response to the annual climatic calendar (Hawksworth, 1984; ICRISAT, 1980; Lal and Russell, 1981; FAO, 1978; Cusack, 1983; Porter, 1979).

- In areas where the length of the climatic season is a constraint on the selection of crops or crop sequences, critical periods in the agricultural cycle such as land preparation, weeding, or harvest may limit the aggregate land in production and thus the overall productivity of the farm unit.

- Climatic seasonality, in conjunction with the diversity of farm enterprises, determines the pattern of labor input needs. It is typical that farm labor is a limiting factor during at least one period during the season. Partial and disguised unemployment may occur at other times, with labor available with no obligatory commitments.

- Climatic seasonality in the lowland tropics is determined by the availability of water to mee plant evaportranspiration needs; thus, the period of photosynthetic activity is constrained by the rainfall (or irrigation) seasonality. For this reason, production areas must be, in general, larger in areas of shorter growing season. At the same time, the available "window" for field preparation or other activities may, through labor bottlenecks, limit farm size.

- Annual rainfall totals and annual summations of length of growing season may hide patterns of single, double, and (rarely) triple seasons with intervening dry periods sufficient to prevent continuous production of crops unable to draw upon a deep bank of soil moisture or do tolerate dormancy (e.g., cassava).

para. 66-77 - Edit to eliminate redundancy

Utilize renewable and non-renewable resources effectively.

a. Maximize productivity from and minimize dependence upon non-renewable resources (Leach, 1976; Pimentel, 1980; Bayliss-Smith, 1982):

   - In energy-deficit nations, minimize use of technologies dependent on imported petroleum.

   - In petroleum producing and exporting nations, use energy resources for appropriate energy-intensive technologies that are ecologically and economically sound.

   - Minimize dependence on mineral fertilizers and agricultural chemicals based on imported or limited resources.

b. Maximize system closure to the flow of renewable and non-renewable resources. Close the system as much as possible with respect to the flow of non-renewable resources:

  - Renewable resources should not be used at a rate exceeding rates of regeneration.
  - Renewable resources are mortgaged when regeneration rates are exceeded, but regeneration continues.
  - Renewable resources are eroded when use prohibits regeneration.
  - Renewable resources can be enhanced, receiving investments to increase resource availability.
  - Non-renewable resources can only be mined.

c. Utilize renewable resources for sustained productivity. Effectively utilize and recycle renewable resources such as soils, soil nutrients, and plant productivity with a goal of achieving sustained productivity.

para. 79 - Reword a.
para. 80-81 - Omit bl.

Control processes of plant and animal succession.

a. Control successional change from desirable to undesirable plant and animal community structure using weeding, trapping, guarding, fencing or other similar management strategies that fit within the overall environmental management plan.

b. Provide crop and livestock protection.

  - Encourage the use of biological controls and integrated pest management that include natural parasites and predators.
  - In areas with a marked dry season(s), the dry period is a partial control on diseases and pests (Kowal and Kassam, 1978)

para. 93-113 - Reorganize

para. 100 - Should it be dropped? I don't like this statement and would like to see paragraphs 100 to 106 dropped. Paragraph 94 (a.) expresses my feelings.

Increase productivity

a. Focus development efforts on food crops that are wanted and best suited for the each region. Many countries don't allow the transportation of goods from one political district to another. This results in the production of crops on lands best suited to other crops or another land use.

b. Increase productivity to the total land area in the agricultural system. Many traditional African agricultural systems are based, at least initially, on systems of extensive rather than intensive land use -- shifting cultivation and rotational bush fallow. Thus assessment of yields must take into account land areas in various stages of the fallow cycle, as well as land actually in cultivation. A similar principle holds when assessing productivity of rotational rangeland use (see discussion of the land use factor in shifting cultivation systems in Allen, 1965; Okigbo and Greenland, 1976).

c. Maintain enterprises producing subsistence food supplies to the producing unit (even though additional farm and non-farm activities are developed). Thereby reducing vulnerability to disruption of external food sources and reducing vulnerability to food supply related to risks in sources of income for purchase of food.

d. Utilize animal sources of protein, calories, and fat only when animals mobilize resources not directly usable by human populations. The use animals to harvest solar energy in areas too arid or otherwise unsuitable for arable agriculture should be encouraged. They can also be used to collect and concentrate resources in fallow areas and from unneeded crop and processing residues.

e. Develop integrated crop and livestock farming systems that will synergistically enhance both crop and livestock enterprises. Integrated crop/livestock systems at scales that are agronomically and economically viable must be found. Even where diseases do not prohibit use of cattle or oxen, scale of farming controls whether livestock traction is economically viable (Kowal and Kassam, 1978).

para. 117 - Reword

c. Provide plant nutrients for desired yield only after considering all socio-economic and ecological factors.

para. 126 - Explain (Greg should do this)

d. Prevent excessive waterlogging during the season of greatest rainfall.

6- Institutional Aspects of Applying Five Key Practices -

1. Livestock Marketing - Livestock markets in much of Africa are maintained at artificially low values for livestock products. In many cases this is the result of urban politicians giving benefits to the urban population to maintain peace and curb unrest in the urban centers and indirectly to keep their own job and position of power. There is evidence that suggests that people who have traditionally maintained large numbers of animals for social reasons or as a "bank account" will market animals if the market system for livestock was eqitable and dependable.

2. Institutional policy restrictions for transporting goods - In many parts of Africa it is against policy of the government to transportfood items between political districts even within the same country. This policy encourages the production of goods and services within each district regardless of the ecological capability of the land. In Kenya, for example, Maize is produced in every district and on marginal lands that might best

be producing other crops. But since maize is the preferred food and they can't take advantage of surpluses grown in other districts, maize is grown in low potential areas often with a high rate of failure.

3. Drilling wells for stock water and human consumption - The pattern of indiscrimanant drilling of wells across Africa in the semiarid and arid zone has aggrevated the problem now referred to as desertification. Much of this area was utilized by nomadic people whose production system was based on movement. The drilling of permanant wells tends to settle these people around the water source and degradation of these areas accelerates.

   In some cases government policy is to settle the nomadic peoples to gain a greater degree of control over them. Some say that when settled the nomadic people can receive other services like education and health care. The problem that arrises is that there are few, if any, successful examples where these goals have been achieved. Most often the result is desertifacation and people becoming dependant upon famine relief. There is a great need to examine the total system these people are in before deciding to help.

4. Rangeland vegetation management - Vegetation management practices like reseeding, brush control, etc. are seldom successful in Africa unless the institutions involved have the complete cooperation of the people. One of the extreme examples occurred in Jordan during the mid-fifties. Some 3,000 hectares were reseeded with grass and browse species. The plants became established and about 18 months after the revegetation was started, approximately 90,000 camels were brought in from other areas to graze for seven months on the new seeding. Although appeals were made to the institutions involved, nothing was done to control the access to the newly improved land.

5. Most resource improvement activities on extensively used arid or semiarid land require long periods of time (10-20 years) to evaluate success or failure. Development projects have traditionally been tied to the donors 5-year budget cycles and seldom extend long enough to evaluate success. Local institutions often lack the resources and capability to monitor the natuaral resource base and development activities on it.

   It is my opinion that until this situation of short term development projects (5-year) and limited monitoring is changed, agricultural development in Africa will conitnue on its current roller coaster ride. Even though highs are reached, they are not sustained, and Africa continues to lose ground in becoming self sufficient.

7- Replicability/Generalizability of case Studies -

1. Rendilli Development Project - The problems and lessons learned in working with the Rendilli people are probably appropriate for all nomadic and semi-nomadic people in sub-Saharan Africa. The caution to be noted is that Africa is a continnent consisting of many tribes. These tribes do not neccessarily conform to any political boundary and each tribe is quite different from any other. The resulting tribalism is a reality that must be considered at all times.

2. Impact of drought in Kenya - This case study is probably unique to this situation. It does, however, illustrate the changing land use patterns and responce to drought by parts of two tribes. All tribes in sub-Saharan Africa experience these problems regularly and observing the responce of one group may help others develope better strategies to meet the stresses of drought and other changes in land use.

3. Rural Development: The Maasi Range Development Projet - This case study is similiar in applicability to case study number 1. The main difference is that it reports the experiences gain over a longer period of time and evaluates the process of rural development as seen through a sociologists eyes.

Contract Paper No. 2

FINAL DRAFT

Low-Resource Agriculture in Sub-Saharan Africa: Principles and Concepts for Managing Inland Fisheries

by

John H. Grover and Stephen P. Malvestuto

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FINAL DRAFT

COMMENTARY OF NATURAL RESOURCE MANAGEMENT AS IT PERTAINS TO FISHERIES

1. The importance of fish as a natural resource is often under appreciated. Fish are highly nutritious and provide more animal protein for human consumption throughout the world than any other group of animals (Shell, 1986):

Animal Group	Percentage of Animal Protein
Small Ruminants	7
Poultry	11
Beef	23
Pork	24
Fish	35

In many less developed countries fish contribute an even higher percentage of human dietary protein:

Region	Percentage of Animal Protein from Fish
Southeast Asia	60
Africa	25
Europe	13
Latin America	9
North America	5

Fish also provide other products such as fish oil, used in cooking, and fish meal, used as a protein supplement in animal feeds.

2. Approximately 90% of the fish supply comes from capture fisheries. The remainder comes from aquaculture. Capture fisheries are concentrated

along ocean coasts, particularly where there are shallow continental shelves or current upwellings. Inland waters may sustain locally important fisheries but only account for approximately 12% of the overall fish supply (FAO, 1984). Most small scale fisheries are in need of conservation management as stocks serve as valuable sources of food, employment and income and can be easily depleted, particularly under adverse environmental conditions.

3. A complicating factor with reference to fish resource conservation is the unpredictable effect of climate on aquatic conditions. Disruption of normal hydrological patterns causes water level fluctuations in lakes and changes in flow regimes in rivers. Long-term drought conditions are particularly detrimental because lake levels can drop substantially causing loss of shallow-water breeding habitat for important commercial fishes, e.g., tilapias (Oreochromis, Sarotherodon and Tilapia spp.). Continued low flow in rivers limits annual inundation of floodplains and curtails spawning, growth and survival of many fishes, thus lowering yields (Welcomme, 1985). Conservation policies must of necessity, then, be flexible, with the emergence of more strict measures during periods of adverse climatic conditions.

4. Specific details on the state of the fisheries in any given Third World location are difficult to find and, even when available, usually are not reliable. Most descriptions are based on observation, scanty data or on data from projects of limited duration. Much of the time-honored information on aquaculture production in Asia, for example, has come under

question and now the estimates are believed to be almost half of what was reported earlier (Thia-Eng, 1986). In Africa, this information, though of questionable accuracy, has been adequate enough for development of generalized yield prediction models for lakes (Henderson and Welcomme, 1974; Melack, 1976) and rivers (Welcomme, 1976). These comparative models have enhanced our understanding of factors affecting fish production and fish yields, but have limited value for localized management programs.

5. With respect to fish resource management and fishery development, the primary difficulty to date is not that the biological assessments have been wrong, but that the intervention strategies have been based only on assessments of the population biology of the stocks, and economic and sociocultural considerations have been largely ignored. In an overall sense, the problem has been the lack of a relevant framework, or perhaps more specifically, the lack of an appropriate applied science, for dealing with fishery conservation issues in the rural socio-environmental setting of most African nations. The principles and concepts identified by Knight and Child for managing natural, human and institutional resources for low-resource agriculture, are particularly valuable in this respect, for they provide relevant guidelines for re-orienting fishery assessment goals and management practices. A brief discussion of the relevance of each of the principles listed (A-I) to inland fishery development issues in Africa follows.

6. The recognition that classical biological assessments alone are inadequate and that subsistence fisheries are many times integrated with

other food production enterprises and family activities, carries the implication that an adequate understanding of these systems in Africa must be based on a holistic, or interdisciplinary, methodology. This is, in essence, the first (A) of the nine concepts and principles listed by Knight and Child. Maximization of fish production with all that it would entail, is not necessarily maximization of benefits to fisher families, or others, when fishing is viewed within an appropriate sociocultural context.

7. The second principle (B) states that development assistance should enhance the positive links between individuals, institutions and external resources. Though applicable to fishery management issues in Africa, this principle is not wholly adequate. The positive links certainly should be enhanced, but it may also be necessary to greatly modify weak, or negative, links which currently exist and will be necessary for successful fishery development programs in the future. In other words, the players (individuals and institutions) may well be the same, but their roles need to be redefined.

8. At present, the primary management structures in place are those instituted by the colonial governments. These structures are based on a particular cultural perception that aquatic resources are common property, open to access by all, and are under the stewardship of a centralized government agency. Thus, the information collected and the techniques used in Africa have not differed substantially from those in practice in Europe and America. These approaches are inappropriate in the African setting and more effective methods must be identified in accordance with principles

(C), (D), (E) and (F) of Knight and Child. Thus, as these concepts imply, there is a wealth of local knowledge, practices and institutions which have evolved over long periods in response to uncertainty, risk, and vulnerability. It is logical that development programs should support these local structures, not disrupt them. Many fisheries, particularly along rivers in West Africa, have evolved traditional management systems which have, until recently, gone unidentified and thus unutilized, as a framework for workable conservation policy (Scudder and Conelly, 1984). The integration of more localized institutional structures into management strategies will enhance the flexibility and diversity of management options and allow local participation in the initiation, design, implementation, monitoring and evaluation of development assistance efforts.

9. With respect to aquacultural development in particular, and with reference to principal (C) which makes reference to using indigenous plants and animals as starting points for development assistance, it should be acknowledged that few indigenous varieties are major crops in any farming system in the world. Most important crops and domesticated animals are highly derived from their natural state and generally are grown far from their native ranges. This applies strongly to the introduction of exotic fishes for culture purposes.

10. There are easily observed family and community roles for members of fisher households which have social importance and must be considered in the application of any development project. Thus, as principle (G) implies, management strategies must be designed, implemented, monitored and

evaluated for their differential effects on various segments of the community. Women play very definite roles in fishing enterprises in Africa, with primary responsibilities in the marketing and preservation of the harvest. They are also largely responsible for the care and nutrition of children; disruption of their money-making opportunities in the traditional structure could produce negative socio-nutritional effects. Special attention to women (principle H) and young children is highly relevant within the fishery development sector.

11. Principle (I) speaks of the necessity for commitment to environmentally, socially, institutionally, and financially sound short- and long-term policies and practices by donors, national governments and low-resource agriculturalists. Commitment must lead to action, however, if viable fishery development methods are to be identified and applied in a cooperative fashion. Communication between donors, national governments and the fishermen is certainly a requisite first step in the development of more enlightened policies. Too many development projects have been conceived without any consideration of how host countries could possibly sustain the programs after project support has terminated. With coordination between agencies, the synergistic complementary contributions that have fortuitously emerged at times, can be applied in a more planned and purposeful manner. Multi-national riverine management is dependent on viable communication and dissemination of information between national governments if the benefits and costs of riverine development are to be allocated equitably among those sharing the resources.

DISCUSSION OF PRINCIPLES AND CONCEPTS/APPLICATIONS

Aquaculture

12. Efforts to establish aquaculture in Africa have been numerous and with only modest success. The Belgian, French and British governments promoted the construction of thousands of small ponds in their African colonies as early as the 1940s (Grover et al., 1980). FAO has subsequently worked with a variety of aquaculture projects in many of the newly independent states and sponsored several technical conferences in the region (FAO, 1975; 1982). The U.S. Peace Corps has been involved with aquaculture projects in at least a dozen sub-Saharan countries. AID and other bilateral assistance agencies have contributed to aquacultural development programs as have church missions and other private groups. Nevertheless, there are yet few examples of significant volume of production following project activities.

13. A variety of constraints have been identified (Grover, 1980; FAO, 1982) and are not different than those associated with the lack of progress with other agricultural projects. These include lack of trained people, poor infrastructure and support systems, unfavorable public policies, political meddling or disruption, lack of capital, inappropriate technology, etc. There have been new ideas brought to production operations since the earliest efforts and many current projects have not really had long enough to judge their long-term impact, however. Certainly

the principles and concepts expressed by Knight and Child have rarely had a chance to be followed to their logical conclusion.

14. There is a need for the fish that can be produced through aquaculture and there are suitable land, water and climate resources available in many places in Africa that can support aquaculture. Appropriate technologies have been demonstrated that are both profitable and within the capability of low-resource farmers to manage (Grover et al., 1980). Water is inherently more productive as a pasture system to produce edible animal flesh than equivalent land areas, so it is logical to work for the development of water-related food production systems.

15. It is important that aquaculture be viewed in the context of agriculture. Cultured fish are an agricultural animal and part of a farming system. The system usually revolves around the supply of water and the production of fish in the water is just one of the many related activities linked to the water and the whole rural way of life. Production of fish is usually a family operation with division of labor according to traditional ways. Production is usually consumed locally by producing families or by passing fish through local marketing channels without processing.

16. In the past there has been the expectation that good yields could be obtained with little concern for direct management. Natives thought they could throw fish into any type of crudely constructed pond and were disappointed when this didn't work, so aquaculture efforts were frequently abandoned.

17. Small pond systems can be the basis of a managed fishery. With only modest effort, such as regulated stocking and improved pond design, this fishery then becomes a low-level aquaculture. The level of control can be increased up to a point that there is an intensive aquaculture involving careful stocking and feeding of fish as well as management of the total environment. For African small farm operations most experts agree that only extensive and semi-intensive approaches to pond management seem practical (Grover et al., 1980; Coche, 1982). The more intensive management systems involve mechanization, costly processed feed and capital investment that are usually beyond the means of small low-resource farmers. Development efforts to benefit low income groups should, therefore, not focus on highly sophisticated or capital demanding systems. Intermittent ponds and tanks in arid areas might best be developed as a managed fishery rather than a controlled aquaculture.

18. Pond construction may be part of a larger soil and water conservation program as it has been in the U.S. Ponds help to check the erosional force of runoff water and, by holding water high in the watershed, reduce the danger of downstream flooding. The water stored in ponds keeps water available in dry seasons that can be used for stock watering, irrigation, drinking and washing, recreation and to support wildlife. Fish also can be produced in the ponds concurrent with many other uses.

19. A general study of the environmental impacts of pond construction has been prepared by Phelps (1981). The conclusion is that ponds are

usually ecologically beneficial. There are a few hazards that may develop with ponds such as the increased potential for schistosomiasis, but usually these hazards can be kept at an acceptable level when measured against the positive effects from water storage.

20. Another environmental concern is with the impact of transplanting new fish species or strains into new areas. The record is replete with many successful as well as disastrous examples of such introductions. It is clear that transplanting species may have serious environmental consequences and should not be done casually. It also is clear that traditional low resource agriculturists are slow to adopt and use strange new technology or products. Nevertheless, the achievement of development goals necessitates that some changes be made and the use of better exotic organisms is one of the best and easiest ways to make rapid progress in a system that is not currently meeting its needs. Public policy should remain open minded on this issue and provide for adequate use by case review rather than establish inflexible policies.

21. The specific opportunities for pond construction vary with each location. Ponds should not be built in sandy soils that will not hold water. They also should not be placed in flood channels where dams will be washed out following heavy rain. Coastal fishponds in brackish water tidal swamps have been built with great success in Southeast Asia and elsewhere but care needs to be taken not to destroy important coastal ecosystems. Often ponds can be sited so they take advantage of natural drainage topography of an area and so they do not encroach on productive crop land.

22. One of the simplest ways to enhance fish production in ponds is by the use of fertilizers. Chemical fertilizers or organic manures can be used to stimulate natural fish food production. Fish may also be fed directly but materials to provide a nutritionally complete diet are usually expensive and in short supply in less developed countries. The same is often true of chemical fertilizers. Nevertheless, some locally available farm by-products such as animal manure, cereal brans and crop residues can often be used to supplement natural foods in ponds to enhance fish production. Efforts to increase aquaculture production should include identification of these local feed/fertilizer resources and the design of production systems that take advantage of this local availability.

23. The highest pond yields come from fish that feed low on the trophic chain. Several African tilapia and a few Asiatic carps are the most widely cultured fish in this regard. Another way to enhance fish yields is to mix species with different food preferences to take advantage of the different food niches in ponds. The Chinese have been particularly successful growing "polycultures" of different fish species in ponds enriched with farm by-products (Tapiador et al., 1977). Inevitably, as aquaculture skills become more developed, there will be a shift to more complex systems such as polycultures to give greater efficiency and yields.

24. Another Oriental approach that is directly applicable to small farmers in places such as Africa is to integrate fish, livestock and garden production into a single system. The local application could take many forms. A typical situation would be for a farmer to have a few small

fishponds, with water enriched with runoff from a small poultry or stock pen. The enriched water from the ponds, besides producing good fish crops, would also be used to irrigate and fertilize a vegetable garden. Garden wastes would then be fed back to the stock or be put into the ponds. The diversity of such an integration reduces the risks associated with any single part of the system and also provides a variety of products for household use or local markets. Small operations can usually be built and maintained with family labor and can be programmed in keeping with traditional demands for time, food or cash crops. Such systems require little capital and remain in the control of the producing family. The Peace Corps program in Tanzania, for example, seems to be making progress with integrated aquaculture systems. This is in contrast to Zaire (see case study), where simpler systems seemed to be more timely.

25. The complexity of the aquaculture development process defies simple solutions or similar approaches. Schmittou et al. (1985) reviewed the impact of various aquaculture development efforts in the Philippines and generally observed that assistance support was helpful and that aquaculture development progresses through a series of stages. Schmittou et al. (1985) also articulated a model describing these stages and the appropriate type of donor assistance and public support needed at each stage. For example, countries with poorly developed agriculture and aquaculture systems would likely best be influenced by small voluntary programs such as church missions or Peace Corps programs. These programs should be modest and directed to create awareness through small result

demonstrations. The systems might work best outside (often corrupt) governments and have the flexibility to adjust to local needs with local participation. The state of agricultural development in Africa in most locations, particularly as practiced by low-resource farmers, would best be at this starting level, with the flexibility to adjust to lcoal conditions.

26. Countries with more developed agriculture and aquaculture may need less technology infusion but might benefit from capital made available to fund aquaculture enterprises. In countries between these two extremes, there would be a need for institutional development with education and research components. As the state of the practice improves in Africa, development support should also shift to these higher-level activities dealing with educational, institutional and capital needs.

Fisheries in Lakes and Rivers

27. As pointed out in the opening section, the principles and concepts of Knight and Child are certainly applicable to development issues in inland capture fishery management. It would seem, however, on a more operational level, that basic principles associated with the biology of the organisms being hunted and gathered, i.e., fish, must be specified and used in association with the development concepts discussed above. A more rigorous treatment of the population biology of the food organisms under consideration would seem to be more crucial with respect to harvest of wild plants and animals, than to cultivated or domesticated organisms, which are under direct care of people. Following is a general overview of the most

pertinent information concerning factors affecting fish yields from lakes and rivers in Africa.

28. The colonial governments in Africa established fisheries departments with the purpose of regulating the harvest and marketing of commercial fish species and, after World War II, experts were hired to study the biology of certain important fishes. During the 1960s and 1970s, international development agencies, namely FAO/UNDP, World Bank, and USAID, became involved in large-scale fishery projects on important natural lakes, e.g., Victoria (Nyanza), Tanganyika, Rudolf (Turkana), Malawi, George (Idi Amin Dada), Chad and others. Emphasis was also placed on the study of the development of fish populations and the effects of fishing in newly created reservoirs on the large rivers of Africa, namely Lakes Kariba (Zambesi R.), Nasser (Nile R.), Volta (Volta R.) and Kianji (Niger R.). The rivers themselves, despite the fact that they contribute an estimated 40% to total fish harvest in Africa, have been largely ignored.

29. At present in Africa, it is estimated that lakes (natural and man-made) and rivers yield 900,000 and 600,000 tonnes (=metric tons or 1000 kg) per annum, respectively, and that this is close to maximum sustainable yield, which can be reached at surprisingly low densities of 1 to 2 fishermen per km^2 on lakes (Henderson and Welcomme, 1974) and possibly up to 10 fishermen per km^2 on rivers (Welcomme, 1978). The fisheries are, for the most part, artisinal in nature, providing income and food on a subsistence basis to localized ethnic groups of fishermen, although migratory fishermen are common. Population pressure coupled with scarcity

of food because of adverse climatic conditions, both north and south of the equator, has caused fishing effort to increase dramatically over the past 10 years as traditional fishermen and others attempt to utilize fish resources more intensively for food and income. Thus, although for certain systems there are estimates that yield can be increased, e.g., 70% for Lake Victoria (Marten, 1979) and 30% for Lake Tanganyika (Hecky et al., 1981), it is more common to find situations where overfishing has occurred.

30. Technically, overfishing occurs when harvest begins to decline in the face of increasing fishing effort; biologically, the breeding stock has become too small, because of excessive harvest of adult fish or of fish before they can reach maturity, to support itself at previous levels of abundance. There are numerous examples of this kind of effect on larger, more commercially valuable fishes in African lakes and rivers (Welcomme, 1978; 1985; Kapetsky and Petr, 1984). These larger species, usually piscivores, do not have the productive capacity to sustain heavy fishing pressure and are the first to drop out of the fishery. As piscivores are removed from the system, the other smaller and more prolific species that were being preyed on, become more abundant. If these species are acceptable by the public, then yields can actually increase as fishermen take advantage of the increased availability of fish that once served as food for the predators in the system. If the fishes that increase after overharvest of piscivores are not valued by the public, then, benefits received by people have been reduced. Marten's (1979) strategy for increasing yield from L. Victoria was based on increased piscivore harvest

to stimulate production of forage species residing at lower trophic levels. Theoretically, this would increase both the magnitude of harvest and the economic value of the fishery.

31. In L. Tanganyika, increased yields of small clupeids (*Stolothrissa* sp.) and certain predators (*Luciolates* sp.) were directly attributable to overharvest of the top predator, the Nile perch (*Lates niloticus*). African rivers may not have the resilience at lower trophic levels to respond effectively to a reduction in predator mortality so that overexploitation of the entire fish community is possible. This has been documented for the lower Oueme River in Nigeria (Welcomme, 1985) and is the current situation on the southern portion of the Niger River in Niger (Malvestuto and Meredith, in press).

32. Although inland fisheries in Africa have been severely affected by fishing pressure, it is often difficult to implicate only the fishermen because fluctuating climatic conditions can influence aquatic environments greatly and can exacerbate the detrimental effects of fishing pressure. Thus, the trend in increasing effort and declining catches indicative of many of the lakes in Africa during the late 1960s and early 1970s was associated with ever increasing drought conditions and declining water levels. The community overfishing which has occurred in several West African rivers (Senegal, Niger, Chari-Logone) is certainly a result of relatively high fishing pressure combined with severe drought conditions in the Sahel. Positive correlations between water level (or flows in rivers)

in one year with yield to the fishery, 1 to 3 years later, have been documented for both lakes and rivers (Welcomme, 1985) in Africa.

33. Fish species have been moved around quite freely on the African continent. Some introductions have been accidental, and purposeful ones have had both positive and negative effects. The introductions of the Lake Tanganyika pelagic clupeids into Lakes Kariba and Kivu have been successful and viable commercial fisheries are now in existence on those lakes. Nile perch, on the other hand, introduced into L. Victoria has inflicted heavy predatory mortality on smaller fishes traditionally used by the people around the lake, impacting detrimentally on the place of smaller fishes in the peoples' diet; additionally, the Nile perch is too large for the preferences of most people living around the lake and marketing is difficult.

34. The following concepts on the biology of natural fish resources in Africa can be distilled from the above discussion:

- Fishing effort, using currently available equipment and techniques, can affect the abundance and size structures of fish populations, particularly in lakes, but also in rivers.
- Preferential harvest of large piscivores causes shifts in community structures that favor the abundance of smaller prey species. This effect is more evident in lakes than in rivers.
- Natural or man-induced stresses can alter the carrying capacity of aquatic environments. Fish resources in rivers are more susceptible to overfishing when flows are depressed.
- The effects of introductions of exotic fish species to increase yields are unpredictable.

35. Particular characteristics of lake and river fisheries in Africa have spurred further development of certain methodologies, narrowed the range of applicable management approaches and identified crucial areas for future evaluation. For example, the influence of climate on African fish resources, as cited above, lessens the applicability of traditional population dynamics models for yield prediction, except perhaps on the very large African lakes which are less responsive to external stimuli, as these models assume constancy of environment. With respect to sampling methodology, the sheer size of some of the water bodies, the dispersed nature of fishing activity and the multiplicity of fishing techniques practiced, has forced the development and application of complex statistical survey techniques to assure the validity of the information collected (Bazigos, 1974; Malvestuto et al., 1980). With respect to management, it is now very apparent that the kinds of management options that are a part of the fishery biologist's conventional repertoire, e.g., fishing effort and gear restrictions, closed seasons and areas, restricted harvest, species introductions, and habitat modifications, have limited application in the African setting because of the sociopolitical structures that exist in the developing countries on that continent. Conventional fishery biology, conducted in the name of management, only has value if integrated into an appropriate, applied methodology. Thus, the necessity to blend fishery biology principles and development assistance principles into workable fish resource management methods.

36. It will help to identify and emphasize those development principles of Knight and Child that are relevant to the fishery biology concepts just derived, and are particularly critical at present if progress in inland fishery management in Africa is to be made. A reasonable starting point is to list the primary limitations to effective fisheries management for African lakes and rivers. These are:

(1) Overriding influence of environment on carrying capacity;

(2) Continued emphasis on the production aspects of fisheries with little emphasis on distribution and consumption components;

(3) Continued treatment of fisheries as separate entities dissociated from other household enterprises;

(4) Lack of appropriate socioeconomic indicators of benefits derived by families and communities through fishing;

(5) Not enough government personnel adequately educated in natural resource management;

(6) High expenses associated with adequate data collection;

(7) Centralized government fisheries agencies steeped in the top-down management approach that was instituted by colonial regimes with little regard for localized institutions and traditional systems of natural resource management; and

(8) Lack of educational and extension techniques specifically applicable to artisinal fisheries.

37. If the development principles of Knight and Child are truly applicable to fisheries management problems, then they should serve at least as partial solutions to removing the limitations. The following relations are plausible in this regard, where the limitations are numbered as per the previous paragraph and the applicable principles are listed with letters as per the opening section:

Limitation	Principles as Solutions
(1)	A,B,D,E
(2)	A,B,H
(3)	C,D,H
(4)	C,G
(5)	I
(6)	E,F,I
(7)	D,E,F
(8)	G

The principles are very interrelated and thus there is appreciable overlap in the relevance of certain principles to certain problem areas. The general applicability of these principles to fisheries management problems was discussed in the opening section and will not be repeated here; but, there are certain considerations that deserve emphasis.

38. The fishery biology concepts derived earlier indicate, as a whole, that fish resources are affected by people and also by other exogenous factors, climate for example. The viability of these fish systems depends on man's ability to use, and simultaneously adapt to, fish resources as changing entities. In the traditional science, when characteristics of these fisheries are measured, the change manifests itself as variability in estimates of catch, effort, CPUE, etc. This variability can make what seems to be appropriate assessment and management at one point in time, totally inappropriate at some later point. This unpredictability in conditions is obviously a hindrance to development of strict, eternally-applicable, fishery regulations. Fisher families and communities, however, have evolved with this uncertainty and risk, and thus their social systems for dealing with these difficulties are adaptive, have

intrinsic value, and should not be destroyed. More appropriately, they should be nurtured and used to advantage in development of assistance programs.

39. A positive case in point comes from Mali as documented by Sissoko et al. (1986). Here, the Bozo and Somono fishermen divide the river waters adjacent to their communities into fishing zones called "bamo." Each bamo is opened and closed on specific dates. Some bamo are left opened permanently as a daily source of food for the community. Opening and closing dates are flexible to accommodate unusual situations; for example, most bamo are put in reserve earlier and stay closed longer in years of low water. Management of bamo is in the hands of the village chief, the spiritual leader and the council. They decide which fishing zones will be in reservation, fix the opening and closing dates of the zones, estimate the part of the harvest that should go to the community for public purposes, and provide effective protection. Generally, the reserves are protected by a community watch program; however, the council may select some of its members as guardians. It is in the tradition of the community to respect the rules, and violating them is regarded as a crime and an act of dishonor.

40. At present, this management system is being pressured into change due to population increase and continued entry of foreign fishermen, such that many restricted fishing zones are being transformed into common properties, and economic, nutritional and social benefits to local fishing communities have declined (Sissoko et al., 1986). Although the Government

of Mali (GOM) has recently declared the Niger River to be a public property, the GOM generally recognizes the existence and value of the traditional management structure and has encouraged its continuation.

41. Even where these traditional social management structures do not exist, management strategies can still be patterned after documented cases, as it certainly seems that the traditional fishery management systems are more akin to land use practices and other territorial rights that are integrated into African cultures. Community involvement is intrinsic to the use and management of fish resources under traditional approaches, and development strategies that integrate into these structures will be less likely to be socially insensitive. Family and community roles, such as fish marketing and preservation by women, will be a part of management, rather than ignored by it. This kind of development assistance embodies several of the principles referred to earlier.

42. It is unlikely that government agencies now in control of management policies in African countries will relinquish this control very easily, and workable management plans may likely be based on acceptable definition of roles for the players involved. In most cases, however, fisheries agencies are at rudimentary levels with respect to organization, management, definition of responsibilities, adequacy of trained administrators and field personnel, and the existence of conservation ethic. Given the precept that the use of indigenous fishery management structures is desirable, then government agencies can become meaningfully

involved in effective management, only if they are re-structured in purpose and developed accordingly.

43. From what is known about the structures of the traditional fishery management systems, such as the Malian example given above, and particularly with their integration into other agricultural and livestock practices, it is reasonable to approach their management in terms of the overall farming, or food production, system. Thus, a farming systems research and extension (FSR/E) approach is a logical starting structure. The primary objective of FSR/E is to improve the welfare of individual farm families by increasing the effectiveness of the farming system in utilizing the limited resources within the context of the entire range of private and societal goals (Shaner et al., 1981; Monu, 1983). This objective is consistent with the view that fishing is a household enterprise, integrated into a complex of other land-use practices and societal roles and values. (See Sissoko et al. (1986) for a detailed discussion of FSR/E as applied to fishery management).

44. If artisinal inland fisheries in Africa are viewed as parts of farming systems, then the linkage between localized management and government assistance would logically be served by an extension agency. Thus, rather than placing first priority on policing fisheries for violators of, many times, ill-founded regulations, these agencies should be:

- Gathering and disseminating information that would be of benefit to fishing communities in planning their management strategies.

- Working with fishermen on the application of new fishing methods or management ideas.
- Monitoring responses of fish resources and other components of the farming system to various management practices.
- Helping to enforce strict fishing regulations when warranted and agreed to by all parties involved.
- Helping to enhance communication between different fishing communities and between other national fishery agencies, particularly when different countries are sharing the same aquatic system.

45. International development organizations can play a meaningful role in both the development of methodologies and the building of governmental infrastructure. Integrated, multidisciplinary projects limited in number, but well defined in scope, must be conducted. It is necessary now to develop and test data collection methods, apply management plans and document management effects. Thus, long-term involvement (minimally 7 years) is justified, but with a phasing of project emphases over time. Education and training of government agency personnel would necessarily be an integral part of project activities. Donor organizations that can function on a localized, grass-roots level, e.g. Peace Corps and private voluntary organizations, with proper technical supervision and support can be valuable for extending project influence into the social fabric of the community, as per FSR/E.

46. On a larger scale, given the multi-national nature of many fisheries, particularly along rivers, international communication networks charged with the dessimination of information on environmental conditions, current status of fisheries, and research and management programs underway,

would greatly enhance the overall development of management policies and the effectiveness of conservation decisions, particularly when the activities in one country may affect conditions in another. This is becoming more critical as nations make plans for increased use of aquatic resources which may entail large-scale manipulations such as damming and use of floodplain areas for agriculture, that can have far reaching effects downstream.

CASE STUDY

Zaire Fish Culture Expansion Project

47. In 1978 a Fish Culture Expansion Project was implemented by USAID and the Peace Corps in Zaire. The Project built on earlier experience dating back to a basic feasibility study done in 1973 and subsequent efforts by a few Peace Corps volunteers (PCVs) working in rural communities with small farmers. This earlier experience demonstrated the technical and economic feasibility of small-scale tilapia culture in family operated fishponds and provided an understanding of local conditions, both in the biology of fish production using techniques improved since colonial days and of the culture that resulted in reorientation, particularly of the institutional framework in which the project was to be oriented. The Project provides for PCVs to serve as extension agents and for USAID to provide transportation support in the form of motorcycles and fuel. The initial Project was for 5 years, but following a review in 1984, was extended recognizing that 10 or more additional years would be needed to achieve the development objectives. Change comes slowly in rural African communities and a sustained long-term commitment appears essential in this Project.

48. The Project has an annual budget of approximately $1 million, used 80% to support the 60 or so volunteers. The PCVs receive intensive training both in the U.S. and in Zaire before being sent to their posts. Training involves language, cultural sensitivity and production technology.

Generally, PCVs are posted in "clusters" in a region targeted as being suitable for fish culture. Each volunteer works actively with 10-25 progressive farmers often helping them renovate poorly built older ponds and getting them initial stocks of Nile tilapia. The idea is to create a group of successful producers in the target area who will serve as a nuclear group from which the technology will spread based on its own success. Cooperating farmers are organized into support groups to share their experiences and assist each other. Thus the farmers are drawn into the development process and, through these associations, become responsible for their own success without perpetual dependence on external programs. After about 6 years extension services can be withdrawn and new target areas developed. By 1986 approximately 35,000 ponds have come under some influence of the Project and several producer groups were still operational even after Peace Corps support had shifted away.

49. The Government of Zaire is a partner in the Project but their main contribution has been in allocation of small fish hatchery stations that help provide selected strains of fish for initial stocking of farmers' ponds. The Government is usually destitute and with a poor image in rural areas. One of the responses to Project design was to create a system that mostly worked outside of the government and central control, deemed essential for any local acceptance.

50. The Project has been criticized on a cost-benefit analysis, the actual production area being influenced is not large. Project advocates argue that benefits need to be measured on more than an immediate cost-

benefit basis. Protein and income produced, though not great in absolute terms, are locally important and build on a near zero base. Participating farm families are realizing some of the goals of development that include non-monetary features such as expanded choices and better control of their lives. They also are learning the benefits of cooperation and how adoption of new technology can be beneficial. Development agencies need to be aware of results that are not immediately measurable in quantitative terms and have patience with the development process.

51. In extending the Project several points were emphasized as a result of the first experience. One was the logic of using fish as the place to start with basic animal production. Fish production gives a more dramatic payoff and is more forgiving in implementation than alternative animal production programs. Another point was that experience had demonstrated the need to keep the system simple, restricting activities just to fish culture. The Project needs to focus on a few quality operations rather than spread lessor efforts over more farmers. Integration approaches of fish production with other animal husbandry may follow but are too complicated for initial startup. Processing and marketing systems are not needed at current levels of production as there is a ready local market for all fish that can be harvested for same-day consumption.

52. A judgement of the success of the Project is still not possible. It is clear that Peace Corps regards this as one of its best programs and that PCVs are extremely committed when they see the results of the

production technology in practice. Many of the returned volunteers have gone on to seek career work in international development. The Project also has shown how different development agencies can complement each other in a joint effort, Peace Corps providing the manpower, USAID the operational support. This Project also tests an approach to official aid that does not closely align with a less than beneficent host government and may serve as a model for what could be done in other countries or with other farm commodities.

53. Zaire does have a rather settled population and this system may not be directly transferable to pastoral or shifting agricultural groups. The tilapia-compost production system is a good choice for the humid tropical regions of Zaire but may be less suited for more arid regions where compost materials are scarce or for highland areas where lower temperatures will necessarily slow biological processes. Tilapia can be easily reproduced in ponds, thus bringing control of seed production directly to the farmers rather than creating a usually fragile seed supply system. Tilapia are already well known and readily accepted in most of Africa. The Nile tilapia offers a species of wide food range, which eventually could be supplemented with other fishes with specialized food habits to take advantage of the inherent efficiencies of polycultures.

CASE STUDY

The Niger River Fishery in Niger

54. There are periodic descriptions of the fishery on the river in Niger from the early 1960s until 1980; but methods of estimation were different and the accuracy of the values is certainly questionable. The work done during the 1960s suggests that during that period, there were roughly 1,500 active fishermen on the river with an associated annual harvest of 4,000 to 5,000 tonnes, giving a catch per fisherman per annum of 2.7 to 3.3 tonnes. Niger government figures for 1978 give an annual harvest of about 5,000 tonnes, but it is likely that this was a perpetuation of earlier figures and no estimate of fishing effort was given. In 1980, it estimated that there were 2,600 fishermen operating on the river and induced, through an economic evaluation of fisher households, that the harvest per fisherman per year was about 1 tonne, giving a total harvest estimate of 2,600 tonnes.

55. Relating the generalized situation in the 1960s to the 1980 figures suggests that fishing effort may have doubled during the 1970s with an associated decline in harvest per canoe. The influx of people to the river basin area was a logical consequence of the drought and it is reasonable that more people would have entered the fishery during this period. Thus, it is likely that the 1980s ushered in a situation on the river characterized by decreased flow regimes and relatively high levels of fishing effort.

56. During 1983-1985, a detailed study of the river fishery was conducted. By this time, fishing effort had declined to about 1,300 fishermen and harvest was below 1,000 tonnes, indicating a highly depressed fishery. Over the three-year period of study, both catch and effort were declining rapidly and significant regional differences had developed along the river in Niger. The most southern section, which had been subjected to the highest levels of fishing effort historically, was severely overfished and the fishery had collapsed; effort dropped by 90% over the study period and fishing success was about 50% of that found in the northern section. Larger fish were conspicuously absent from the harvest in the southern region; the large majority of fish caught had not had an opportunity to spawn. The situation on the Niger River in Niger embodies several of the fishery biology concepts derived in the discussion earlier.

57. During 1983-1985, fishing was contributing about 80% of the income of fishermen, based primarily on the sale of the larger, more commercially valuable fish species. Appropriate management strategy, then, based on the economic benefit derived by the fishermen, would dictate that the larger fish be protected. Fishing regulations had been established at some time in the past and were wholly inappropriate. The highly sophisticated traditional management systems of the local fishing societies had been abandoned as the fishery service of the Nigerian government attempted to impose regulations on the people with no sound basis relative to the biology of the fish stocks, or relative to the benefits derived by the fishermen. Agency infrastructure and orientation were completely

inadequate for enforcement of regulations even if they had been appropriate.

58. Donor organizations with no experience in fisheries development perceived that the problem with the fishery in the south was that the fishermen did not have good enough equipment to exploit the stocks, so gave new canoes and nets to the fishermen in that area which simply exacerbated an already critical situation. A marketing cooperative was also formed in the southern region with no consideration given to the marketing role of women in the society and with little understanding by the fishermen involved as to the functioning of the cooperative and what they should reasonably expect from it. These attempts at fishery revitalization in Africa are typical and are examples of lack of a sound operational definition and methodology for fishery management.

59. The management approach developed from the recent study is built around the organization of fishermen associations regionally along the river. The organizations are being established using traditional village hierarchies and fishermen are anxious to partake in the management of their regions of the river. Management responsibilities are divided between the fishermen associations and the government fishery service. Blanket regulations that are applicable to the entire length of the river in Niger, e.g., total restrictions on particularly detrimental types of fishing gear, will be the responsibility of the fisheries service and the associations; regulations which best vary regionally, e.g., restricted fishing areas, limitations on migratory fishermen, will be under the purview of the

associations. Documentation of the effects of the management recommendations will depend on acceptance of the management plan by the Niger government and financial support by donor agencies. Further assistance will also emphasize reorganization of governmental fishery service infrastructure to better interact with, and respond to, input by the fishermen organizations and training of Nigeriennes as fishery monitors and fishery extension agents.

DISCUSSION RELATED TO GOALS OF DEVELOPMENT

60. From the above discussion it should be clear that the Knight and Child "Principles and Concepts" appear implicitly valid for fisheries and aquaculture development. The need for a sustained and flexible approach with an understanding of local resources and socio-economic and political systems as well as local participation are well documented needs for development. The problem is how to deliver such programs given the realities on both sides of the North-South alignment of nations. Natural resources, including aquatic ecosystems, are not very well managed for long-term conservation and development in either the developed or less developed world.

61. Fortunately, there is a growing number of less developed countries that seem to be more aware of the development process and that are becoming more responsive in the types of programs that they support. Many LDCs surpass donor countries in the extent of their central planning for natural resource development to the point that America and other developed countries could benefit from their example and experience. The point being that the development process can be a two way flow of benefits, which is one very important reason America should be committed to participate with development efforts in other countries.

62. Fish from the inland waters are generally a renewable resource mostly harvested by low-income people. To the extent that the resource can be protected and enlarged, either by conservation of wild stocks or by

expanded and improved culture activities, low-income people should benefit by the food produced or the employment generated. This food and employment is a direct goal of development.

63. Many other types of "development" activities may actually be quite detrimental to fish resources. Dam construction, for example, in spite of its positive impacts, often changes habitat causing a change in the types of fish found above and below the dam. Use of water for industrial or agricultural activities may result in its pollution and loss of ability to produce fish. The Silent Spring scenario of Rachael Carson is still very much a need for concern, especially in less developed countries where environmental monitoring is less common and where banned chemicals of the West are still in common usage.

64. Some conservationists would categorically argue against any modification of habitat, introduction of new species, or use of chemicals in agriculture or pest control. Others would argue for the absolute preservation of indigenous human cultures. We feel these views are short sighted, but agree that proposed changes need to be evaluated carefully to be sure that the innovations bring the desired development progress and are worth the costs to traditional systems.

65. Population growth also is a source of growing pressure on fish resources that threatens to undermine all development efforts. Without belaboring this already well appreciated concern, dealing with the problems of population growth needs to be directly tied to any natural resource development program.

66. As implicated in earlier discussions, many of the development assistance needs for fisheries management reside external to the production system itself. It has been estimated, for example, that about 40% of the fish harvest from the Niger River is lost due to poor post harvest processing and storage practices. This problem has been addressed in Mali to some degree by the introduction of storage sacks soaked in a biodegradable insecticide which prevents infestation of fish flesh by maggots and beetles. Also, there has been some experimentation with fuel efficient, more effective, smokers for preservation because current methods are very rudimentary and preserved fish usually deteriorate over a number of weeks. Thus, development directed at storage and processing bottlenecks is of high priority.

67. In most instances, the harvest from inland fisheries is disposed of, either fresh or processed in some manner, locally, so that marketing is not necessarily a severe constraint. It might be desirable in certain instances, if supply is adequate, to distribute preserved fish further away from these natural resources to augment food supplies elsewhere. However, development assistance aimed at the processing, storage, marketing and distribution components of these systems, must be conducted in a very socially sensitive manner as family and community roles are traditionally tied to these activities and can be easily disrupted if social considerations are ignored. For example, marketing cooperatives may displace women from their traditional roles as links in the marketing system between the fishermen and the local markets.

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Contract Paper No. 3

FINAL DRAFT

LOW RESOURCE AGRICULTURE IN AFRICA

Principles and Concepts of Productive Human Resource Systems

by

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Department of Anthropology
The American University

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July 1986

FINAL DRAFT

Principles and Concepts of Productive Human Resource Systems

By: Anne Fleuret
Department of Anthropology
The American University

Prepared for the Office of Technology Assessment, U. S. Congress
Under Contract No. 633-2765.0

Final Draft, July 1986

3/10/86

Low-Resource Agriculture in Developing Countries: Implications for Africa

WORK STATEMENT

Title: Low-Resource Agriculture in Sub-Saharan Africa: Principles and Concepts for Productive Human Systems

I. Background Information

OTA is commissioning information from three authors on the principles and concepts for 1) natural resource management, 2) effective institutions, and 3) productive human resource systems. We have chosen these areas in order to emphasize each in a manageable way. We recognize that the distinction between human and institutional resources can be unclear. As OTA uses these terms, "human resource system" means social units such as households, groups, villages and communities with which low-resource agriculturalists have direct contact. The "institutional resource system" means the formal organizations, such as government agencies, private voluntary groups, etc., which serve functions such as research, training, and extension and which deal with broader economic, social and political environments.

Each author's written material should focus primarily on the one assigned resource system. OTA will conduct a workshop for the authors and other participants to discuss how management of the three types of resource systems can be integrated.

A. Definitions and Characterizations

The author will use these definitions and characterizations:

1) Low-Resource Agriculture: Agricultural systems used by poor, small-scale farmers and herders that rely principally on local inputs in order to support household activities. While these systems are diverse, they generally share certain important characteristics, such as being:

- low-risk rather than high-yield
- low-cost
- dependent upon local knowledge
- dependent upon biological processes and renewable resources
- adapted to local environments and cultures
- dynamic and experimental within constraints imposed by risks
- diversified

2) Low-Resource Agriculturalists: A heterogeneous group of rural people who generally are poor and who have limited access to and control over land, water, labor, capital, external sources of information and technology, and external inputs such as commercial fertilizer.

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B. Assumptions

The author will undertake this work with the following assumptions or will consult with OTA before using others.

1) Many people consider low-resource agriculture as the problem that prevents increasing food production in Africa. Instead we consider it both a problem, since low-resource agriculturalists are poor, and a solution, since solutions must match existing conditions. Therefore we will build upon existing opportunities instead of focusing only on removing constraints.

2) Food and livestock production is a major activity of low-resource agriculturalists but they may also engage in cash crop production, fish-farming, forestry, and food processing and marketing. While the focus of this study is on Africa, we expect to examine technologies and policies in a broader context of the developing world and United States' agricultural interests.

C. Goals of Development

The author will accept that low-resource agriculturalists in Africa should themselves determine their development goals and that their strategies will be varied. Effective and appropriate U.S. goals to assist them are:

1) to increase people's quality of life, e.g., reduce drudgery, expand choices, increase income and employment, and improve health and nutrition.
2) to reduce vulnerability.
3) to maintain, build upon, and improve indigenous resources and systems.
4) to ensure economic and environmental sustainability.
5) to improve the quantity and quality of agricultural production.
6) to remove or reduce production, marketing, storage, and processing bottlenecks.

II. Specific Responsibilities of the Author

A. The author will take part in a one-day meeting at OTA on March 19, 1986 to discuss, with several other contractors and OTA staff, the contents of this work.

B. The author will prepare written material acceptable to OTA by May 1, 1986. This material will not exceed 65 pages; material that exceeds this limit is not acceptable to OTA and does not fulfill this contract. This material will include:

1) a brief, 1-2 page list of principles and concepts that apply to productive human resource systems in low-resource agriculture in sub-Saharan Africa. This list should summarize and accompany a 5-page commentary describing the principles and concepts. In the commentary, the author should note other experts' ideas and identify key literature on the subject but this section is not meant to be exhaustive.

2) a discussion of how these principles and concepts have been and can be applied to development in sub-Saharan Africa. This discussion should emphasize practices (see suggested contents), e.g., mobilize under-used and un-used labor skills, and:

   a. include the technical aspects of application, e.g., food for work.

   b. include the institutional aspects of application, e.g., allow PL-480 funds to be used in food for work programs.

   c. identify constraints to application, e.g., ineffective delivery systems.

   d. consider how ecological and social diversity might affect applications, e.g., examine how applications might differ in arid vs. humid regions, or in pastoral vs. sedentary societies.

   The author will illustrate these applications with examples, not necessarily from Africa. This section should be no more than 30 pages long.

   OTA and the author agree that she will devote 10% of this discussion to non-farm activities and that she will show connections between those activities and agricultural production, distribution, and consumption wherever possible.

3) an appendix of 5-8 brief (1-2 page each) African case studies illustrating the applications discussed above. Are these examples replicable? Why and how have they worked or not worked?

4) a brief discussion (no more than 5 pages each) of:

- o How would application of the author's principles and concepts for productive human systems affect the six goals of development set out above? What conflicts arise; what trade-offs are necessary?
- o How could different development assistance organizations, e.g., AID, PVO's, effectively apply the author's principles and concepts for productive human systems? What impediments exist?

C. The author will take part in a 2-day workshop at OTA during June, 1986, to integrate the author's material with that of the two companion papers. This meeting will produce Congressional options for encouraging such integration, e.g., by passing new legislation, changing appropriations, carrying out oversight, etc.

OTA will circulate all authors' contributions to this author during May, 1986 and:

- o the author will address briefly (no more than 5 pages) how the principles and concepts for productive human systems can be integrated with those for managing natural resources and effective institutions in order to achieve our development goals. This material will be submitted to OTA by June 1, 1986.

D. The author's work will be reviewed by the assessment's Advisory Panel and other peers and the author will respond to comments and revise material as needed. This review will take place prior to the meeting of the June working group, with revisions due one month after the meeting.

- o The author will provide, with other written material submitted by May 1, 1986, the names and affiliations of three potential reviewers.

III. Format for Written Materials

A. All written materials will be submitted typed double-spaced on 8 1/2 by 11 inch papers.

B. If possible, these materials may also be submitted via IBM-compatible disk or via modem to OTA's IBM or NBI system.

C. A complete list of literature cited will be included, following the examples attached.

D. Literature referenced within the text will be cited as (Author, year).

E. Information attributed to personal communications will be cited as (Name, pers. comm., date). These names will be included in the list of literature cited, with the communicant's affiliation, and address.

F. The use of footnotes is optional but, if used, they should be submitted separately at the end of the relevant material.

G. If acronyms and technical language are used, they will be defined in the text and a list of acronyms and glossary included.

H. Photographs, slides, or other types of illustrations will be included with the delivered material if available. A numbered list of these will be included with the written material.

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of productive human resource systems

- A. Ensure access to, control over, and mobilization of local productive resources
- B. Minimize risk
- C. Blend cultural continuity with change
- D. Match the multiple goals and functions of groups to the actual needs, perceptions, and priorities of individuals
- E. Ensure a functional internal division of labor
- F. Ensure equity through participation in decisions, actions, and benefits affecting individuals and groups (focusing on who and how rather than just numbers in all stages of planning, implementation, evaluation, and benefit sharing of projects and programs)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use by human systems of the resources (i.e., land, water, labor, and capital) they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use of resources of human resource systems (including some examples -- with more detailed examples to be appended as case studies)

- A. Labor:
  1. mobilize underutilized and unutilized labor and skills, e.g.
     - a. food for work
     - b. etc.
  2. maximize local employment opportunities
     - a. provide local opportunity for small scale service industries
     - b. provide training and local materials to capitalize on opportunities
  3. maximize productive potential of all members of agricultural labor force
     - a. reduce drudgery
     - b. value unpaid work of members
  4. improve skills through training
     - a. demonstration farms, etc.

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of effective institutions

- A. Ensure wise use and development of human resources (e.g., technical skills, attitudes, numbers of people) to serve low-resource agriculturalists
- B. Ensure wise use and development of capital and other assets (e.g., money, infrastructure, inputs, knowledge, policies, procedures) to serve low-resource agriculturalists
- C. Develop ability and accountability to sustain development process for low-resource agriculturalists
- D. Develop capability for flexibility: adaptability to cultural context; capacity for institutional learning; development of a diversity of strategies to deal with diversity of needs
- E. Use criteria for selection, development, and diffusion of technologies that consider technical efficiency, advantages accruing to the household (e.g., income, reduced drudgery, status) and advantages accruing to society (e.g., income distribution, employment, resource conservation, foreign exchange)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use of and development by institutions of the resources (e.g., labor and capital) that they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use and development of institutional resources (including some examples -- with more detailed examples to be appended as case studies)

- A. Capital and other assets (e.g., procedures)
  - 1. ensure local participation (i.e.,)
    - a. planners must go out to field
    - b. extension workers must link farmers and researchers
  - 2. provide timely delivery of money, information, inputs, services, etc.
  - 3. must allow for problem-solving and not prescriptions
    - a. must address diverse needs of diverse groups
    - b. planning should be iterative process incorporating feedback
    - c. must use and develop management skills (e.g., administrative, priority setting, research management, etc.)

Companion Paper on Natural Resource Management

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of natural resource management

A. Increase productivity: measure of output per unit of resource; eg, yield, income

B. Improve quality: defined by its benefits to the humans in the system (nutritional, medicinal, etc)

C. Ensure sustainability: ability of system to allow continued or improved productivity

D. Ensure stability: ability of system to maintain productivity in spite of disturbance (eg, varying rainfall, fluctuations in market prices). Most conveniently measured by the reciprocal of the coefficient of variation in yield or income

E. "Close" the system as much as possible: reduce the loss of resources other than through harvesting

F. Rely on biological processes as much as possible

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices for managing energy use, water use, land use, pest control, and maintenance of genetic diversity . For example:

I. Low-resource agriculture in sub-Saharan Africa: Management practices (including some examples --- with more detailed examples to be appended as case studies)

A. Practices for managing water use:

1. maintain vegetative and/or litter cover to reduce runoff and evaporation

2. maintain soil organic matter to increase infiltration, allowing the soil to act as a sponge absorbing and holding water

3. maximize spatial heterogeneity of roots to minimize leaching

4. use plants and animals adapted to local water regieme

5. use water harvesting and irrigation techniques that use water renewably rather than mining it; e.g.,
    a. diguettes in Burkina Faso (increase infiltration and reduce runoff, thereby increasing productivity and "closing" the system)
    b. etc

3/86

Food & Renewable Resources Program

EXAMPLES FOR REFERENCE STYLE
(alphabetized by author's last name)

Clark, C.O. "Saline-Seep Development on Nonirrigated Cropland," pp. 22-33 Proceedings Saline Seep-Fallow Workshop. Highwood, MT: Highwood Alkali Control Association, 1971.	(Paper in conference proceedings)
David, W.H. (ed.). Desertification of the United States. Washington, DC: Council on Environmental Quality, 1971, 142 pp.	(Edited Book)
Donstreich, M.D., Leopold, A.C., and Ardrey, R. "Food Habits of Early Man: Balance Between Hunting and Gathering." Science 179:306-307, 1973.	(Multiple Authors journal article)
Frederick, K.D. "Irrigation and the Future of American Agriculture," The Future of American Agriculture as a Strategic Resource, S.S. Batie and R.G. Healy (eds.) pp. 157-190. Washington, DC: The Conservation Foundation, 1980.	(Article in edited book)
Pirie, N.W. "Orthodox and Unorthodox Methods of Meeting World Food Needs." Scientific American 216(2):27-35, 1967.	(One-author journal article)
Robertson, L.S. Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI. Personal communication, Aug. 5, 1981.	(Personal communication)
Sheridan, D. Desertification of the United States. Washington, DC: Council on Environmental Quality, 1981, 242 pp.	(Book)
Shih, S.F., et al. "Subsidence Related to Lane Use in Everglades Agricultural Area." Transactions of the American Society of Agriculture Engineers 22(3):560-563, 1979.	(More-than-3-author article)
"Two Firms Fined $4,000 Each for PBB Contamination of Cattle Feed in Michigan." Toxic Material News p. 144, May 1978.	(No author named)
Voorhees, W.B. "Soil Compaction, How It Influences Moisture, Temperature, Yield, Root Growth." Crops and Soils Magazine 29(6):14-15, 1977a.	(Same author, same year or different year, alphabetize by title)

Voorhees, W.B. "Soil Compaction, Our Newest Natural Resources." Crops and Soils Magazine 29(5):26-27, 1977b.	(Same author, same year or different year, alphabetize by title)
U.S. Congress, Senate Select Committee on Nutrition and Human Needs. Dietary Goals for the United States. Washington, DC: U.S. Government Printing Office, 1977.	(U.S. Congress)
U.S. Department of Agriculture, ESCS. "A Process of Identifying Emerging Social and Economic Issues and Implied Research Needs." Unpublished draft report, Washington, DC, October 1979.	(Unpublished draft)

I. Principles and concepts of productive human resource systems: list and commentary

The relevant units are individuals, households, larger kin groups, communities, and informal, formal, or special-purpose groups such as labor companies. Linkages between these units, as well as their incorporation into local and regional institutions and processes, also are significant.

1. Flexibility in composition and membership of household or other unit of social organization;
2. maintenance of large and diverse social networks;
3. retention of potential to mobilize kin, age, and other co-operative groups;
4. decisions made and implemented situationally by individuals, households, kinship groups and communities;
5. complementary nature of gender roles;
6. diversification in the local and regional economy;
7. flexibility in tenurial arrangements, allowing maximum access to land and other resources;
8. management of risk through flexibility in the agricultural system and through crop diversity;
9. indigenous experimentation and innovation in the agricultural system;
10. maintenance of production systems that are multifaceted, mobile and flexible (Grayzel 1986);
11. complementary nature of the existing division of labor and

multiple mechanisms for the recruitment of labor, for agricultural, enabling, and non-farm activities;

12. access to and individual management of multiple sources of income;
13. generation of off- and non-farm income, especially from the rural sector;
14. participation in migratory wage labor and/or the income transfers that attend it;
15. maintenance of rural-urban linkages;
16. exercise of locally-generated initiative and participation, usually manifested at higher levels of inclusion such as the community;
17. mobilization of informal and other organizations such as labor companies, rotating credit associations, and women's groups;
18. availability of reliable market outlets;
19. availability of sources of flexible, small-scale credit, and a range of agricultural inputs.

Although this cannot be phrased as a principle of productive social systems, it must be recognized that institutionalized inequality of rural households exists, and that both social and economic inequality at the community level are commonplace. This topic is discussed at the conclusion of the narrative portion of the paper.

As used in this paper "human resource systems" refers to the forms of social organization that manage the allocation of land, labor, and capital, and which mediate production, distribution and consumption in the rural setting. The term household is generally used to indicate the unit that is the nexus of such processes, but the household as a concept has proven difficult to define and manage. The principal criterion of a household is co-residence, and for rural Africa the main determinant of co-residence is kinship, by descent, by marriage, or both, although many kin-based households may have members--often in a dependent status--who are non-relatives (domestic servants, tenants or boarders, pawned or foster children). Thus household and family are not interchangeable terms. There is no absolute conformity to culturally-generated ideals of household structure and/or composition. Such arrangements tend, rather, to be flexible, and household membership contracts and expands in response to opportunities and constraints. Moock points to the difficulty of defining household membership due to the incorporation of various categories of kin and non-kin, polygyny, membership changes due to migration, employment or long-term visits, and individual control of income and assets; "Further complications arise when one attempts to sort out linkages among different types of households, since labor relations and other forms of exchange also tend to be more individualized than is assumed in Western-based household models and since gender is often a key mediating factor" (n.d.:5).

These caveats do not mean that the household cannot and should not be the focus of inquiry in the African situation. Guyer's (1981) assertion that rich-poor, senior-junior, and gender relationships cannot be studied in a household context is erroneous, for it is within the household that such relationships are most explicity played out. Rather, "The household is a fundamental social unit. Households are more than groups of dyadic pairs. They have an emergent character that makes them more than the sum of their parts. They are a primary arena for the expression of age and sex roles, kinship, socialization, and economic cooperation....Decisions emerge from households through negotiation, disagreement, conflict, and bargaining....Pooling and sharing of resources, food processing, cooking, eating and sheltering from the elements tend to take place in the household..." (Netting et al. 1984). While individual decision-making and productive activity are undeniably important in the African situation, individuals do not make their decisions or go about their activities in a vacuum, but as part of a more inclusive unit which affects their decisions, choices, and access to resources, and which as well provides them with access to labor and a base from which to mobilize support networks grounded in kinship, neighborhood, and other principles.

Although there are some places, such as rural Rwanda, where households are not functionally incorporated into larger and more inclusive social units, this is rather rare; Hart (1982) asserts that in West Africa kinship structures such as unilineal descent groups are still the pre-eminent forms of rural organization. This is arguable; although particular individuals and households may exercise claims to particular resources through their wider kinship ties, the increasing individualization of rights in land, labor, livestock and harvests shows the weakening of these institutions. Accounts from such unilineal descent-dominated areas as Hausaland and rural Mali attest to this increased individual control, whether it be temporary or permanent (Raynaut 1976, Pollet and Winter 1976). As Lipton notes, even in those places where such control is said to continue, effective repossession and redistribution of assets by a descent group is essentially unenforceable (1985). Nonetheless, kinship, age and gender provide bases for the recruitment of informal organizations such as women's groups and labor companies which may be ephemeral and impermanent but which perform important functions for their membership.

Communities are in some areas of increasing importance. These are often artificial entities created as a consequence of the state's desire for effective control over its citizens, although in West Africa particularly towns and other supra-household and supra-kin group organizations with a territorial basis have long-established identities. Their isolation as a discrete administrative unit and their frequent ethnic homogeneity provide a basis for common action. In West Africa it is often expected that successful individuals will make substantial contributions to their home town, whether they live there or not (Brokensha 1963, Berry 1985); in Kenya, locally-generated initiative and participation are manifested in harambee self-help activities at the level of the community, sublocation, or location (cf. Thomas 1980).

At one time it was commonly held--and still is believed by some--that socio-economic variability among households within a community or region is a function solely of their various stages of progress through a domestic cycle (cf. Goody 1967, Guyer 1981). It is now increasingly recognized that considerable institutionalized inequality exists in rural areas (cf. Little 1985) in addition to domestic-cycle variability, and various methods have been devised to measure the extent of such inequality (Castro et al. 1980; cf. P. Fleuret 1979, 1980). Economic as well as social stratification is a reality in rural Africa which in places pre-dates the colonial period (Hart 1982), which must be recognized, and which has much significance in terms of access to land resources, education, employment opportunities, and other scarce goods, and the ability to take advantage of opportunities.

Mechanisms ensuring wide access to rights in land are essential, particularly in light of the existing division of labor, which frequently allocates different but complementary farming tasks to household members on the basis of gender (A. and P. Fleuret 1977, Guyer 1980). There is a prevailing concept that women bear the primary responsibility for producing food for household consumption. Threats to women's access to land are thus threats to household food supply. Increasing restrictions on land access also threaten farmers' ability to practice risk-managing agriculture by, for example, maintaining multiple farmplots in differing micro-environmental zones (cf. A. Fleuret 1985). Dispersed plots are part of a farming strategy which also often includes crop diversity, interplanting of varieties, and indigenous experimentation and innovation; these techniques have been shown to be effective in minimizing risk of total crop failure and may even enhance output (Belshaw 1980, Johnson 1980, Johnny et al. 1981, A. and P. Fleuret 1985), and they should to the greatest extent possible be maintained.

But at the same time it is essential to recognize the fact that in most parts of Africa, household needs exceed productive capacity. As Kershaw notes for the Kikuyu of Kenya, "They do not desire, nor are they capable of, reverting to subsistence farming. Their need for money necessitates wage labor" (1975/6:187). Hence the importance of diversification of the local and regional economy, and the strategic importance of market outlets which serve not only as points of sale for agricultural commodities and of purchase of food and consumer goods, but as foci of rural non-farm employment generation as well. Off- and non-farm work have been shown in a number of studies (cf. Rempel and Lobdell 1978) to be essential to the viability of low-resource agriculture and to be more remunerative as well. Those without access to such employment are almost invariably poorer than those with it (cf. P. Fleuret 1980). The generation of rural employment that is compatible with continued food production has been proposed as a development strategy for Kenya (P. and A. Fleuret 1983, Livingstone 1985). Even long-term migratory wage labor necessitating the withdrawal of adult men from household and community seems to result in net gains for rural areas, and in both types of employment some of the proceeds are reinvested in the agricultural sector.

The key to viable human resource systems in sub-Saharan Africa thus lies in preserving their flexibility of structure and membership; in maintaining their strategy of tapping diverse sources of income, both on and off the farm; in recognizing and building on existing task allocation and labor recruitment mechanisms; and in encouraging continued experimentation, innovation, and diversification in the agricultural system.

II. Development applications of the principles and concepts of productive human resource systems

A. Household organization, situational decision-making, and gender (principles 1-5)

Although an outstanding characteristic of African smallholder households is their flexibility in terms of membership and task allocation processes and their ability to mobilize support from beyond their immediate boundaries by virtue of their linkages to other households and more inclusive social units, regrettably these characteristics have not often been taken into consideration or turned to the advantage of development. Very often Western household concepts have implicitly or explicitly informed planning and the autonomy of individual household members has not been recognized or exploited. Women in particular have been penalized. As a consequence their ability to carry out particular productive and/or income-generating activities may be compromised by the introduced innovations.

The significance of households headed by women is an emerging theme in the development literature, but the label "woman-headed household" may obscure as much as it illuminates. This is because women become household managers through a number of mechanisms, each with its implications for household viability. A woman's position as household head may be temporary or permanent, by succession, by decision or by default. Widows and divorcees may opt to become household heads by their decision not to re-marry (Nyhus and Massey 1986); and in such a case manage or even inherit property left by their husbands (Obbo 1986, Oboler 1985). In Kenya and Botswana in particular (A. Fleuret n.d., Brown 1983, Oboler 1985) increasing numbers of women who have never been married establish their own households with their children. Cases are cited of married women who by their ability and personality become heads of households which also contain their husbands (MacCormack 1979). There is considerable uncertainty over the status of married women in nuclear households whose husbands are absent as labor migrants; a substantial number of such women in Lesotho state that they remain subordinate to their absent spouses in the realm of decision-making (Gordon 1981), while Kenyan wives manage and make decisions about all aspects of farm and household operation (Hitchings 1982, A. Fleuret n.d.). Despite this, it is well-established that women are unequally served by extension and credit facilities (e.g. Staudt 1977, Fortmann 1985). Blurring of these categories of female-headed households, or failure to recognize the management capacity and role of many women farmers, should be avoided, particularly in the structure of credit and extension services, and employment generation.

Even in households where men are present, some or much of the responsibility for food production falls to women. Simmons (1976) and Hill (1972:335) note that among the Muslim Hausa, where seclusion of women (purdah) is an ideal, certain age and life-status categories of women own farms and perform agricultural tasks. In some parts of Tanzania women provide 60% or more of the labor for particular crops (Due 1986). Although the role of African women in agriculture is well-documented and the determinants of their farming roles are the subject of much theoretical debate (cf. Burton and White 1984), Due's observation that women's participation in farming was ignored by Tanzanian officials (1986), and Fortmann's that consideration of female agricultural activity is conspicuous by its absence from AID agricultural project design documents suggest that reinforcement of the point is not only appropriate but essential. Many descriptions of the gender-based division of labor prevalent in African farming systems note the allocation of the responsibility for household food production to women, while men are responsible for commercial production. This is not the only variable functioning as a basis for differential labor allocation, but it can be an important one. Because such a division may already exist, agricultural projects may deliberately or unintentionally target innovations or new crops to men without considering their potential impacts on labor allocation and income earning opportunities for women (cf. Dey 1981, Jones 1983).

In theory, African farmers as individuals and regardless of sex control, enjoy, and dispose of the returns to their labor as they wish. In Sierra Leone, adults, both male and female, make their own farms, maintain their own granaries, and control all the income they generate from their own agricultural activities (MacCormack 1979). According to Linares, "Freedom to experiment, change tactics, make decisions about what to do or how to allocate one's labour is individual and complete among the Diola" of Senegal, as is control over returns to labor (1981:567). Liberian women farm to produce food and crops for sale, the income from which is theirs to manage (Johnny et al. 1981). Even secluded women among the Hausa manage a "hidden trade" in prepared foodstuffs, the proceeds from which are sufficient to protect them from their husbands' poverty (Hill 1969). There are numerous other examples which demonstrate the autonomy of individual household members in agricultural and economic affairs (cf. Whitehead 1984). Hence households should not be thought of as unitary organizations directed to the fulfillment of common goals; nor is it correct to assume that any one member has total knowledge of economic resources and activities of all members. There may even be competition between members over particular resources (Reynolds 1982).

As a consequence of agricultural development projects which distort existing intra-household task allocation processes, female labor is increasingly being redirected to the service of commercial crops, at the expense of household food supply and often at rates of return below the prevailing market (cf. Due 1986, Etienne 1977, Dey 1981). For example, in Uluguru, Tanzania, men control 80% of income, realized mainly from agricultural sales, but women provide 45% of agricultural labor (Mtoi 1986:5). The Mideco project in Cameroon is attempting to accomodate the existing farming system by training both male and female extension agents and by targeting improvements in coffee production to male producers, and high-yielding varieties of maize to women who already grow maize for household consumption (Koons, pers. comm. 1986). Hence, recognition of the differential agendas and activities of men and women farmers in the same household is something that can be built into the implementation of a development project; the existing division of labor can be built upon, provided that it is understood in the first place. As Fortmann (1985) has shown, project design is all too often based on minimal understanding of such dynamics; social research at an early point in the development of a project can do much to make it more effective.

Summary: Development applications of principles 1-5

a. maintain household flexibility and decision-making capacity by de-centralizing or localizing projects, and recruiting project leadership from the local community;
b. facilitate access of all household members to extension services and sources of credit, as well as other resources and inputs;
c. carry out research on gender and variation in both women's tasks and the nature of female-headed households in a project area prior to project design and implementation;
d. assess the potential impact of projects on both men and women;
e. contribute to autonomy and decision-making power of individual household members by making innovations freely available to all, rather than targeting them to specific age or gender groups.
f. Avoid using Western household models to conceptualize gender relations, division of labor, and the like in African farming households.

B. Flexibility in access to land; risk management; agricultural innovation, experimentation, and diversification (principles 6-10)

The flexibility of household structure and organization has been stressed, as has the capacity of individual household members to pursue their own ends relatively independently of the interests of other members. Recognition of the complementary nature of male and female activities is essential, since innovations can affect the ability of one sex or the other to carry out his or her obligations. Of particular concern here is the question of access to resources, of which the most fundamental are land, labor and capital. I will consider land first. There is considerable current debate over a number of land-related issues; the questions of tenure arrangements and of landlessness are particularly important.

There is a prevalent, Rousseau-ian notion that traditional African land tenure systems were both "communal" and egalitarian, and thus access to adequate land was guaranteed to all. But as Noronha (1985), Lipton (1985) and Hart (1982) have pointed out, traditional landholding patterns were not necessarily egalitarian; in any society land was governed by a number of different access and control arrangements ranging from "commons" (usually pasture) to individual ownership and commercial transactions; in any case land use was to a very large degree on an individual basis, and institutions controlling that use, such as descent groups, could do little to interfere. What is true is that landholding and land use arrangements were, and to a large degree still are, flexible, and that most individuals desiring it still have access, albeit inequal access, to land for farming.

Individuals obtain rights to the use or ownership of land through a variety of mechanisms, including inheritance, occupancy, clearing, purchase, rental, borrowing, squatting, government bequest, loans, and more (cf. Biebuyck 1963). Because of the complementary productive activities already discussed, both men and women need access to land, but while male access is often direct, women more often obtain rights to the use of land through men to whom they are related as spouses or daughters. Again to use the extreme example of a society where women are, by African standards, minimally involved in agriculture, in a Hausa village in Niger one-fourth of the farmplots were under the control of women. Most control was on the basis of use-rights obtained through spouses, but women also inherited, rented, and purchased land (Raynaut 1976). An unfortunate effect of tenure reform has been to make permanent existing inequalities in the distribution of land (Kershaw 1975/6, Haugerud 1983) or to abrogate women's limited rights of ownership, as opposed to use (cf. Pala 1978, Mighot-Adholla and Okeyo 1984, A. Fleuret 1986).

Another aspect of flexibility in landholding patterns that is increasingly threatened by population increase, development, and tenure reform is the pattern of plot dispersal so important as a risk-managing device in many African farming systems. Taita farmers of Kenya, for example, typically own from six to 30 small parcels located in various locally-recognized ecological zones, and cultivate several of them simultaneously during each of the three farming seasons in a complex system of rotation based on soil type, rainfall, and the characteristics of the particular crops involved. Liberian farmers try simultaneously to cultivate rice crops with very different soil and moisture requirements in different areas (Johnny et al. 1981). Kofyar farmers of northern Nigeria grow intensively-cultivated food crops near to their hillside homes, and extensively cultivate quite different cash crops on the plains at the base of the hills (Netting 1968). Diola women grow wet rice on flooded land, while the men produce dryland groundnuts and millet (Linares 1981). For hill people in particular plot dispersal in different climatic zones increases the chances of harvest even in the most difficult years (A. Fleuret 1985). Land reform which creates a single holding rather than permitting the strategy of multiple plots threatens the viability of such a system of production. As Noronha (1985) notes, there is no evidence that such systems of traditional tenure lead to inefficiency in farming, and thus little justification from the agricultural side for tenure reform in Africa.

In conjunction with plot dispersal, crop diversity is another very important mechanism for managing risk and for ensuring adequate nutrient intake as well. A number of studies have shown the association between agricultural development, reduced crop diversity, and declining household nutritional status (P. and A. Fleuret 1980a). Maintaining a large inventory of crop varieties also reduces the chances of total crop failure, and if intercropping (i.e. planting many crop varieties in the same plot) also takes place, yields may actually be enhanced (Johnny et al. 1981). Farmers should be encouraged to continue the production of so-called minor crops (Longhurst 1983) and to experiment with them. Excessive reliance on a single species for food can have devastating consequences if the crop fails; if the emphasis is on one single commercial crop, for which a lump sum payment is received, nutritional problems may also ensue if the funds cannot be equitably allocated over the intervening period until payment is again received.

Summary: Development applications of principles 6-10:

a. maintain the system of plot dispersal;

b. encourage the conservation of "minor" crops and locally-developed or adapted varieties of staple crops;

c. initiate agronomic research on minor crops and local varieties of staple crops;

d. Ensure access of all household members to land resources rather than registering holdings in the name of only one member;

e. discourage policies in which the state, or a development project, annexes land or controls its allocation.

C. Labor allocation and recruitment; multiple income sources; off- and non-farm employment; migratory labor (principles 11-15)

While land is clearly the sine qua non of agriculture and steps must be taken to ensure access to it and to permit the continuity of traditional techniques for exploiting it, labor also is a resource, and its mobilization and allocation are a key issue in African development. Much confusion exists in the African literature, development-related and otherwise, on the availability of labor for agricultural production. On the one hand, many authors, (cf. Lipton 1985, Swindell 1978, P. Fleuret 1985, Hecht 1985) argue that the principal limiting factor in maintaining, much less increasing, agricultural production in sub-Saharan Africa is shortage of labor. On the other hand, many authors speak of rural unemployment and underemployment, propose development projects based on the premise of abundant labor supply (cf. Wallace 1981), or urge the introduction of new technologies permitting the smoothing of seasonal peaks in labor requirements, or permitting continuous rather than seasonal agricultural production. Let us first of all examine mechanisms for mobilizing, providing, and generating labor, and then constraints on labor availability and techniques for obtaining it that may be created by age, sex, season, gender, skill and opportunity.

Many micro-studies emphasize the pre-eminent role of household or family labor in agricultural production. In many case the kin-based domestic unit is the principal source of labor in food production for that unit. Thus, in studies of rural Taita agriculture, where two-generation conjugal households consisting of a married couple and their minor children are the usual unit, an estimated 80% of all labor for food production, including clearing, planting, weeding, harvesting, transport, and processing, is provided by those members. In extended units among the Hausa of Nigeria and Niger, consisting of a man, his wife or wives, unmarried children, and married sons and their spouses and children, it is again the members of this group who provide labor both for production to satisfy consumption needs of all the members, as well as in production for themselves as individuals. Above the household level, kinship often provides the basis for recruitment of extra labor in times of peak of demand, but as Painter (1986:201) notes, "...the sense of obligation to respond to these requests is less..." than at the household level, or requests between siblings, or parent and child; clearing and weeding are the principal tasks demanding such wider assistance. Bride service, where a man performs specified tasks for a specified period for his wife's parents as an obligation of marriage, and task sharing among co-wives are forms of labor mobilization among kin created by conjugal rather than lineal ties.

Neighborhood, age, gender and religion are also foci for the mobilization of labor which is essentially reciprocal in nature, that is, remunerated in the form of similar assistance or by food and drink consumed at the time the service is rendered. Villagers may ask for help with a specific task such as clearing a new field and compensate those who respond by providing a lavish meal, beer, or both. Men, especially young men, form groups or companies which cultivate on each member's farms in rotation (Swindell 1978, Johnny et al. 1981); women frequently do the same (MacCormack 1979, Linares 1981, Burnham 1980, Dey 1981). In Taita members of a given church may exchange labor among themselves.

There is considerable testimony to the decline of these traditional labor-generating mechanisms, kin-based and other, and their gradual replacement by hired, cash-remunerated labor, often with no preexisting relationship between employer and employee. This too can be organized in many ways. Often, individuals make known their availability as daily labor and are hired by fellow-villagers, kin or non-kin, at an agreed upon rate for a specific task or period of time. In rural Kenya this rate is about Kshs 20/- per day, although persons renowned for their speed and skill may earn twice that amount. Burnham (1980), Raynaut (1976), Hill (1972), and others all provide accounts of such daily labor. "Strange farmers", migrants in the Gambia, provide labor to groundnut farmers in exchange for a piece of land and the opportunity to produce their own cash crop; in one Gambian village, over 40% of households incorporated a strange farmer (Swindell 1978). In Liberia, Sierra Leone, and Senegal, the previously described labor company or kafo, which may be composed of men or women (cf. Linares 1981) may hire out its services to non-members for cash or kind payment. Dida cocoa-farmers of the Ivory Coast recruited labor by selling small, inferior land parcels to non-Dida migrants, who make up the shortfall in their cocoa production by providing wage labor to their Dida patrons (Hecht 1985). Sharecropping where farmers with large tracts which they do not have the labor to cultivate supply land to those with inadequate holdings in exchange for a share of the items produced from that land or of the cash from their sale is another mechanism for re-aligning agricultural labor.

Clearly there is a large array of institutions beyond simple wage hiring whose function is to make certain that labor is available when needed or for tasks beyond the capacity of the household's labor supply. But labor generated through such mechanisms is not equally available to all members of a society; in particular young men, poor people, and women of all ages have less access: young men because, especially in extended households, they may be under the nominal authority of senior males who have first call on their work capacity (cf. in the gandu system of the Hausa, Hill 1972, Raynaut 1976, Painter 1986); the poor because they lack the resources to hire workers or to provide food and drink for a work party, or because they must themselves work as casual laborers to augment income. Women suffer under multiple disadvantages. They can only rarely command the labor of men; as heads of household they are often impoverished; frequently they must assume a greater and greater proportion of agricultural work to replace absent male labor migrants (Tembo and Phiri 1986); households they head are smaller and have fewer adult members (Nyhus and Massey 1986, Brown 1983); and as Guyer argues (1984:381) they may lack the institutionalized access to labor that men have (although this is not always or even usually the case; cf. Linares 1981, MacCormack 1979). Women in particular suffer the additional constraint of the burden of domestic chores or "enabling activities" of which they may perform better than 90%. These chores include cooking, child care, and water and fuel collection. Fortmann argues that these tasks contribute so significantly to the viability of the agricultural household that they should more correctly by regarded as a form of indirect

agricultural production (1985). In Taita, such activities demand a greater share of women's time than farming does.

Season also has an effect on labor mobilization, and in particular a contrast may be seen between areas with but one rainy season followed by a prolonged dry season, and those where bimodal rainfall, more evenly-distributed rainfall, and/or cultivation of tubers and tree crops rather than cereals occurs. In the former case, characteristic of the West African savannah, there is a high demand for labor compressed into a three to four month period which may also be characterized by food shortages, high incidence of disease, difficulties in transport and communications, high prices, and shortages of cash (cf. Chambers et al. 1979, Bleiberg et al. 1980). Once this intensive effort has been rewarded with a harvest, usually of cereals such as millet and sorghum, there is little need for agricultural work until the onset of rains as much as seven months later. During the colonial period, and perhaps before, it became commonplace for men to seek seasonal agricultural work in the forest or coastal zones of West Africa, in cocoa or as strange farmers, returning home again in time for the next planting season. This seasonal "unemployment", more properly a shift in economic activity, is one fact giving rise to the notion that labor is abundant, at least at certain times of ~~the year~~; but the migrants' income may be as important to the household as their agricultural activities. On the other hand, in areas such as Taita, or Beti (Cameroon), the crops grown and the nature of the seasons require regular, much less intense labor inputs. Taita women spend about one-fourth of daylight hours in agricultural activity at all times of the year; by contrast, in

Burkina Faso women farmers spend about five hours per day in agricultural activity during the wet season, but none at all during the dry season, when farm work is replaced by manufacture of handicrafts (Bleiberg et al. 1980).

To sum up: there are many mechanisms for mobilizing labor, but not all members of the household will have equal access to these institutions and the labor they supply, and this inequal access may be exacerbated if the cropping system is markedly seasonal.

Before moving on to consider how existing institutions for and flexibility in labor recruitment might be accomodated in projects seeking to increase agricultural production, it is important to note that agriculture is not the only, or even necessarily the most important, labor-consuming productive activity undertaken by low resource farmers. Off- and/or non-farm employment is important for smallholders in Botswana (Brown 1983), Tanzania and Zambia (Due 1986), Kenya (Fleuret n.d., Little 1985, Sperling 1985), Cameroon (Koons pers. comm. 1986, Burnham 1980), Nigeria (Hill 1972, Wallace 1981, Flinn and Zuckerman 1981), Niger (Raynaut 1976), Sierra Leone (MacCormack 1979), Senegal (Linares 1981, Reboussin 1986), Mali (Pollet and Winter 1976), and every other country. Keith Hart observes that in West African agriculture "...perhaps the central issue...[is] the multiplicity of occupations and tasks within which farming is normally embedded..." (1982:77), and this is equally true in other parts of the continent. In a comparison of Yoruba villages, Flinn and Zuckerman found that non-farm income comprised 17 to 25% of total net household income, and concluded that "...non-farm sources of income contributed substantially to the net income of the family farm" (1981:830). In

Northern Nigeria Wallace's survey of 312 male Hausa farmers revealed that 300 of them practiced three or more non-agricultural occupations simultaneously with farming (1981:294). Only 24% of a sample of 100 Rukuba men (Nigeria) were able to rely solely on agriculture as a source of income; others worked in the mines or as wage laborers to supplement farm income (Muller 1978). Norcliffe and Freeman have studied non-farm activities in rural Kenya, noting that they are second only to smallholder agriculture as a source of employment. There are important links between agriculture and these small enterprises: 42% of the owners of small rural businesses also owned a farm, and the income generated from non-farm activity may be used to support the farm through purchases of inputs, land and/or labor; alternatively, farm profits may be used to generate capital and operating expenses for a business (1980:52 et seq.). Characteristically, the non-farm enterprise requires little capital, has very low overhead, and makes use of un- or under-compensated family or household members as employees. The range and scale of activities comprising non-farm employment is enormous, from daily casual labor to small-scale food processing (cf. Simmons 1975), petty trade, crafts, carpentry and metalworking, charcoal burning, tailoring and shoe repair, domestic service, and civil service, including teaching. Lipton (1985) states that evidence from studies in eight developing countries shows that one-third of rural income but only one-fourth of work originates outside the agricultural sector, so that non-farm activity provides better remuneration than farming.

Remittances, or transfer income, received from absent individuals such as labor migrants, are also significant sources of non-farm income. Short and/or long-term migration, principally by males in the age group 20 to 45 years is commonplace in most African countries. Such migration may be rural-rural, rural-urban, or even international (from Senegal to France, for example) and may have a duration of months or years. The prevailing pattern is for wives and children of such migrants to remain in the rural areas and manage rural assets on behalf of the household. Women farmers left in such a position have in the past been thought to be disadvantaged, and in some instances this does seem to be the case, especially in Lesotho and Botswana where smallholder farming is essentially not viable and where labor constraints are very serious barriers to production (Brown 1983, Gordon 1981). However, studies in Kenya, Nigeria and elsewhere have revealed the following: wives of labor migrants are materially better-off than women whose husbands are not and have never been migrants (Fleuret n.d.); such women hire labor to replace that of absent spouses, thus monopolizing the already scarce labor supply of the rural poor (Fleuret n.d., Adepoju 1974); while remittance money is used principally to satisfy consumption needs, it also has important investment functions, especially in education, housing, and livestock and land purchases (Rempel and Lobdell 1978, O'Leary 1981 and 1983, Knowles and Anker 1981); and the net flow of remittances is from urban to rural areas. According to data presented by Knowles and Anker (1981:210) only 6.3% of the cash total of 1166 income tranfers moved from rural to urban places. The majority of migrants do make remittances, amounting to from 8 to 20% of the migrants' income (Adepoju 1974, Rempel and Lobdell 1978). Rural-rural remittances, from absent villagers working in agricultural or other rural industries, are also significant, accounting for 28.3% of cash transferred in Knowles and Anker's survey (1981) and, in the case of Yombe rural wage-earners in Zaire, providing a net cash income to home villages of CF 341,787 ($2,278) over six months (Lux 1972). The circulation of labor migrants and the information, goods, and other resources they bring with them also facilitates the maintenance of linkages and regular exchanges between rural and urban areas.

African smallholder farming is not at all capital-intensive. Although more and more inputs and new technology which require farmer investment are becoming available, including plows, carts, mechnical cultivators and backpack sprayers as well as improved seed, fertilizers and pesticides, a survey of Taita women farmers conducted in 1985 revealed expenditures on improvements (exclusive of wage labor) of less than $5 per household per year, against mean annual value of food produced for own consumption of $315 (A. Fleuret n.d.). For these farmers the most expensive item generally purchased for farming is a short-handled hoe, an expenditure which is not made very often. Most farming systems still rely on manual cultivation techniques, seed saved from the previous harvest, ash or manure for soil enrichment, and intercropping for pest control.

The cash for major agricultural investments such as land purchases, hired labor or improved livestock is generated not necessarily from farming among rural households, but from off- or non-farm labor. In a sense, agricultural is supported by other forms of employment. However, the studies of non-agricultural income already reviewed suggest that such earners generally place a low priority on expenditures related to agriculture, with the possible exception of livestock purchases. Education is by far the preferred capital investment in most of the societies examined. Children thus learn to value sedentary, urban, non-farm occupations and regard agriculture as a last choice. The large numbers of rural youths, especially males, in Kenya, with a secondary education which does not qualify them for public sector employment and who consider themselves unemployed because their only option is farming provide a sad commentary on their priorities as well as those of their parents. Their labor could clearly be used in the agricultural sector, but for these young men a realistic and politically-expedient alternative might be rural non-farm employment, given their dissatisfaction with present options.

The preceding discussion of labor mobilization for agricultural and domestic activities and for non- and off-farm income generation raises real questions about the viability of any agricultural project which requires large amounts of labor for its implementation or which would require radical changes in the existing patterns of labor allocation in a community or society. Study after study identifies shortage of labor--not land, not capital--as the principal constraint that African smallholder farmers face. This finding also points up the importance of time as a significant factor for development planning. Lunven, presenting data collected from a national sample in Ivory Coast, notes that while on the basis of their food-producing, income-generating, and domestic activities it seems logical to address development efforts to women, existing time constraints are an effective barrier to the success of projects aimed towards them. The first essential step is to devise a strategy for removing such time constraints, particularly those occasioned by seasonal labor peaks (1983:38). Credit programs that provide money to hire labor when such labor is not available, food for work projects that provide inadequate quantities or inappropriate types of commodities, new technologies which ease the labor burden of men at the expense of women, or training opportunities which withdraw the labor of either sex at critical phases in the productive cycle all are inappropriate, unworkable interventions.

Development applications of principles 11-15:

a. reduce labor bottlenecks and seasonal shortages by encouraging the mobilization of labor through multiple channels, and by supplying development resources and inputs through such age, kin or labor-based groups;
b. introduce agriculture into the primary school curriculum in order to encourage school-leavers to view farming as a viable employment option;
c. initiate programs of rural employment generation, by providing credit to owners of small businesses, support for rural markets, and vocational training programs in such fields as carpentry, metal-working, and the like;
d. implement interventions which reduce the time constraints experienced by rural women, such as domestic water or village woodlots;
e. provide training and credit for small-scale enterprise development compatible with farming, such as food processing;

f. introduce appropriate mechanization technologies, such as improved farm implements and ox-plows, and chemical weed control and other technologies to ease labor constraints;

g. increase support to womens' groups for agricultural and income-generating activities.

D. Supra-household organization, credit, and markets (principles 16-19)

Some consideration must also be given to the implications for development of some of the supra-household groups discussed. Mention has already been made of the importance of community or village and the contribution of native sons and daughters to village welfare in Ghana and Nigeria (see Part I above). But there is considerable evidence that development activities initiated, supported and created at the local level are viable and significant. While there are numerous examples of the failure of imposed forms of community co-operation such as communal production in Tanzanian villages, indigenous co-operative institutions built on local kinship and other ties are successful at the same time that ujamaa is not (P. Fleuret 1979). Such institutions may be important for the mobilization of labor (see Part II.C. above), for social support in times of illness or death, as a source of credit, and in building infrastructure. Harambee in Kenya is an excellent example and is discussed in the appendix of case studies. Umuganda in Rwanda mobilizes the labor of all citizens in a particular administrative unit for locally-determined public works activities which benefit that area. Church groups, united by religious ideology and commitment, are an important basis for co-operative agriculture or for the mobilization of cash and labor resources to particular ends.

Women's groups, which may be temporary or permanent, formal or informal, often provide critical services to members, such as marketing outlets, skills training, and capacity to generate income for day-to-day needs or for investment. Groups with an exclusively female membership have often been thought to be ineffective because women may lack the power and authority of a similar group of men, and their needs may be ignored or overlooked by the authorities because of their gender; but when women participate in co-operatives, councils, or other groups where the membership and leadership are predominantly male, they have little capacity to influence the course of events. Painter notes that in Niger women simply are excluded from membership in co-operatives. It is difficult to propose a solution; if women are removed from the mainstream and relegated to gender groups their potential impact may be reduced or they may be diverted into peripheral issues and activity; yet Safilios-Rothschild (1985) argues that separate institutions are the only sure way to ensure female participation, and Fortmann (1985) argues for components of agricultural development projects to be targetted specifically and exclusively to women.

The role of temporary and limited purpose groups--often women-oriented--in the generation of savings and credit is especially important. As Miracle et al. (1980) note, most rural Africans do not utilize formal financial institutions, but it is known that they save (cf. Adams 1981); what mechanisms do they use? The principal institutions are rotating credit associations or savings clubs, spontaneously formed or organized by individuals, with memberships of variable size, many of the members seeking to accumulate a sum of money for investment purposes. The members pay a certain agreed-upon amount of money into a fund at regular intervals, and on each occasion one member receives the total amount of those contributions. There are risks with this kind of institution but there are benefits too: low overhead, quick turnaround, little or no operating expense, little or no interest paid out. Women's groups organized as savings clubs in Kenya are important sources of investment capital for rural women; men employ similar institutions. The money accumulated is used for such diverse purposes as purchase of durable goods, payment of school fees, and purchase of land or livestock (Miracle et al. 1980).

In many agricultural projects credit is a key component of the development strategy, permitting the acquisition of capital assets such as plows or draft animals, or financing consumable inputs or hired labor (Donald 1976). But it is not always effective. Eicher (1986) argues that credit can be effective in conjunction with reliable, thoroughly tested technical packages and with marketing institutions that can ensure reasonable returns and manage the repayment obligation. But where technical packages have been inadequately tested and/or where marketing channels are unreliable, disaster can be the reward of the small farmer who accepts institutional credit. Farmers participating in a cotton scheme in a semi-arid area of Kenya, for example, earned only Kshs 13,021/15 against a debt of Kshs 28,328/10 in 1981-2 (A. Fleuret 1984). While formal credit institutions have been criticized for ignoring the needs of the small farmer, and while repayment experience is not all negative, informal rural credit institutions clearly have a continuing role to play in the investment strategies of African farmers.

Lack of reliable markets has also been a barrier to the development of both food and commercial crop production in Africa. At the community level, local markets are often significant and functional. The importance of local trade in raw foodstuffs and processed items is shown by Hill (1969), Scott (1978), and Simmons (1975). Shambaa and Taita women of East Africa obtain a substantial proportion of their cash income by selling small quantities of produce at periodic markets. But regional, national and international markets may be much less well-organized or integrated. Hazell and Roell (1983) argue that isolation from sources of manufactured goods may skew expenditure patterns in northern Nigeria disproportionately towards food

purchases. Absurdly low prices and inefficiency discourage Tanzanian vegetable farmers from selling their output to parastatal organizations or using official marketing channels.

Development applications of principles 16-19:

a. abolish marketing boards and controlled prices;
b. commit resources to the development of infrastructure such as roads, marketplaces, storage facilities, vehicles;
c. ensure that credit is available in small amounts and in conjunction with institutions that encourage debt recovery;
d. commit resources to enterprise development by informal and/or special-purpose supra-household organizations;
e. foster harambee or other forms of local development generated by local groups or institutions;
f. encourage local-level or "grass-roots" elections for political party representatives, councillors, and the like;
g. solicit suggestions and feed-back from womens' groups, churches,

co-operatives, school committtees, and other local organizations.

E. Some comments on stratification

Stratification, institutionalized socio-economic inequality, is not properly a principle or concept of productive human resource systems. It is nonetheless a characteristic of contemporary rural African society, and is becoming both more important and more prevalent. An increasing degree of socio-economic differentiation is apparent at the community level; it is as significant within communities now as it was between communities in earlier decades. There are a number of factors which account for this differentiation. Some stem from differences that existed in pre-colonial times, particularly in West Africa where centralized states with named social and economic classes and slaves were more commonplace. In the modern settting such differences are often a function of education, skilled employment, and/or accumulation of land, livestock, wives or trading capital rather than hereditary position. With the exception of West African farmer-traders, rural women have a more limited capacity to accumulate through these routes than do men. Wealthy women are often so because their husbands are prosperous. And the prosperity of the wealthiest can be many times greater than that of the average citizen, or the poor.

In rural Taita, the poorest live in single-roomed mud and thatch structures where open wood fires are the source of illumination and sanitation is non-existent; the richest have houses of many rooms with brick or plastered walls, cement floors, iron or tile roofs, indoor plumbing, and electricity. Poor people own their clothes, cooking pots and hoes; the wealthy have modern furniture, automobiles, and large herds of livestock. The wealthy are able to perpetuate their status by investment in income-generating enterprises such as shops, transport, and large farms, and by paying for expensive education for their children. The poor have little to invest; their children attend village primary schools but rarely beyond because of the expense. Studies by Little (1985), P. Fleuret (1980), Patterson (1980), Raynaut (1976), and others, confirm such patterns of institutionalized inequality.

Stratification has implications for equitable development also, because of the demonstrated better capacity of the well-to-do and well-connected to take advantage of such opportunities. Haugerud (1983) shows that wealthy men and civil servants were able to capitalize on their knowledge and cash by acquiring large tracts of land immediately prior to land reform in Embu, Kenya. The wealthy have also been shown to have greater access to extension services, sources of credit, and positions of leadership (cf. Johnson et al. 1980). Although to a certain extent a household's economic status may be affected by its place in the developmental cycle, with very young households and some categories of woman-headed households being among the poorest, and households headed by mature or elderly men who have accumulated wives, herds and other property the wealthiest, life cycle state is no longer a reliable predictor of economic status. Too many exogenous variables have entered the picture. Nor is size of landholding necessarily an accurate indicator because of the constraining effect of labor shortages.

Because of the demonstrated capacity of the already-wealthy to take better advantage of opportunities provided, conventional agricultural development programs have tended to strengthen and increase existing socio-economic disparities rather than to remedy them. This strengthens the argument for local initiative in development, particularly through local institutions whose membership is minimally dominated by existing elites. Churches and women's groups stand out as institutions less likely than many others to be monopolized by the wealthy and powerful. If we accept that one of the primary goals of development is the widespread and equitable distribution of benefits, activities should be designed both to reduce existing inequality and minimize the concentration of development benefits in the hands of the already prosperous.

Development applications to minimize socio-economic inequality:

a. introduce small-scale, low-cost interventions which do not require heavy capital investment on the part of the farmer, such as improved cultivars requiring no other inputs;
b. introduce interventions which can be acquired with the necessity of recourse to extnesion authorities or sources of credit;
c. encourage project implementation through self-help or private voluntary organizations such as harambee, religious organizations;
d. introduce widespread, low-cost basic and vocational education to as as one strategy for breaking the stratification cycle.

III. Case Studies

1. Hybrid maize in Kenya (data drawn from Gerhart 1975; Johnson et al. 1980)

Systematic maize breeding in Kenya began during the 1950s, and the first hybrid varieties were released in 1964. Between 1963 and 1977, USAID invested $1.5 million into agricultural research activites in East Africa, particularly in improvements in hybrid maize and diffusion of the improved seed to farmers. During the first ten years, acreage planted in hybrids increased from 400 to over 800,000, and by 1973 half of Kenya's total maize production was from hybrids. The initial adopters were large farmers, and it was assumed that the expense of yearly seed purchase and the greater risk of failure would inhibit its adoption by smallholders. This was not the case. By 1973 two-thirds or more of the smallholders in the best farming zones of Central, Western and Rift Valley Provinces had adopted hybrids, and their output far surpassed large farm production.

There are several reasons for the high rate of adoption of this improved agricultural technology among Kenyan small farmers.

a. Demonstrated, visible superior yield of hybrids over local varieties, even in the absence of improved husbandry or purchased inputs such as fertilizer;

b. Involvement of the private sector and regular commercial outlets in hybrid maize seed production and distribution;

c. Positive role of the extension service in the promotion of hybrid maize, through contacts with farmers, demonstration plots, fertilizer trials, and Farmer Training Centres.

Not all farmers have benefitted equally from hybrid maize. Farmers with holdings of less than two hectares are much less likely to plant hybrid maize than those with larger holdings. Fear of crop failure and lack of cash to purchase seed and associated inputs are the major barriers. Additionally, neither the provision of credit nor of inputs such has fertilizer has served the interests of the small farmer of hybrid maize, and the extension service has shown a definite bias in the direction of larger and wealthier farmers. Nonetheless, smallholder adoption of hybrid maize has played an important role in Kenyan food security and has permitted an expansion of commercial cropping on the same acreage without requiring parallel reductions in food production.

This example incorporates the principles of risk management, indigenous agricultural experimentation, and individual decision-making. It has been replicated in many parts of the world where farmers have been permitted to make their own decisions about adoption independent of complex and unproven technical accompaniments that increase uncertainty (cf. Wharton 1968) and may also cause indebtedness.

2. The SEMRY I irrigated rice project, Cameroon (Data from Jones 1983)

The SEMRY project introduced gravity fed irrigation for rice production to the Massa people of Northern Cameroon in the late 1950s. At present, individual farmers obtain fields on the basis of contracts with SEMRY in which farmers guarantee payment in kind at time of rice harvest and sale in return for the mechanized plowing, seedlings, fertilizer, pesticides and water management that SEMRY provides. The charges for these services consume about half the yield of the average field. Most decisions--about timing of planting and harvest, amounts of inputs, water supply, producer prices--are made by SEMRY. The only input the project does not control is the allocation of labor to rice production.

Unlike other crops, especially the staple food, sorghum, cultivation of rice is a joint household activity rather than an individual one. In contrast to sorghum, women's rice labor is usually provided to someone other than herself, and is to a greater degree allocated to the fields of non-kin, for which work women are usually remunerated in cash. Most of a woman's rice labor is expended on household plots managed by her husband. Husbands are also expected to compensate their wives in money and rice for the labor they provide on these household plots. The labor is made available partly by reducing the amount of time spent on sorghum but primarily by increasing the annual number of days spent doing agricultural work.

The amount of compensation that women receive for rice labor from their husbands is significantly less than the average daily return to labor generated by the rice crop; but it is substantially higher than income that women could earn from alternative productive activities such as pottery, brewing or trade. Although the returns are low, women still have a net increase in personal income as a consequence of rice labor. The increase is real, in that women do not bear an increased share of household consumption needs as a result. Rice production gives women more opportunities for employment at better returns than they could otherwise receive. When women cultivate rice in their own right the net returns to labor are clearly much higher, but even when compensated by their husbands at rates below the prevailing market the outcome is net increase.

This study illustrates that control over resources, ability to allocate own labor and mobilize the labor of others, and rights to dispose of the returns to labor independently, are important variables in the response to development incentives. As Jones concludes, "The allocation of resources and the distribution of goods is determined according to the complementary and conflicting interests of household members on the basis of their differential bargaining power" (112).

It should be noted that not all centrally-managed rice production schemes permit the limited positive outcome of SEMRY. In particular, projects involving resettlement or those which minimize or eliminate food production potential as well as participation in other income-generating activities can jeopardize all members of the society. Kenyan centralized rice growing schemes such as Mwea-Tebere and Ahero are examples of the sort of project that totally eliminates participant flexibility in land and labor allocation.

3. The Malawi Women in Development Project (Data from P. Fleuret 1984, Fortmann 1985)

About 29% of smallholder farming households in Malawi are managed by women. These households are more likely than not to be found in the lower socio-economic strata and to be severely constrained by labor shortages. They are often unable to obtain institutional credit and are usually unable to produce sufficient food to meet their own consumption requirements. Therefore a considerable amount of their already inadequate labor capacity must be devoted to casual, unskilled work on the farms of others in order to earn money with which to buy food.

Given these generalizations about Malawian women farmers, AID's Office of Women in Development funded a project to improve planning and extension services for women by collection of data on women's agricultural activities, identification of their needs, and preparation of a manual permitting development agencies to determine whether their projects realisticallly address women farmers' needs and concerns. Socio-economic and agricultural data were collected on women and men from three different areas of the country, through which women's lack of access to agricultural information, services and credit was documented, and constraints on both male and female farmers were identified. At the initiative and request of some of the women participants, on-farm crop trials under their management were carried out. Project staff also interacted with Malawians in the Department of Agricultural Development, contributing to curriculum design, data analysis, and program evaluation. Fortmann summarizes the project's accomplishments: "It documents the status of women farmers in comparison with male farmers and identifies their problems. It makes suggestions about how some of these problems can be overcome. It then helps to implement its own suggestions. It involves women farmers as active participants in solving some of their problems through on-farm research" (p. 45).

The data-gathering effort recognized the importance of intra-household dynamics and collected data not only on women but on men, thus ensuring that women's activities and constraints were not examined out of context. The principles of local participation and initiative were employed by asking farmers themselves to identify problems and barriers, and by organizing on-farm trials managed by the farmers who requested them. Some of the materials prepared, especially on extension and curriculum, are models which could be replicated elswhere. And even project critics agree that it was successful in ensuring the inclusion of female farmers as well as male ones as beneficiaries of the extension service. This project is easily replicable and is of very low cost.

4. Harambee in Kenya (Data from Thomas 1980 and author's own observations)

The harambee movement in Kenya involves the implementation of rural development projects by communities or other organizations on the basis of consensus and local initiative. The efforts are decentralized, small-scale, locally generated and participatory, generally demanding the involvement of all group or community members. The development projects undertaken by harambee include building schools, daycare centers, churches, roads, dispensaries, cattle dips, social halls, and water systems. Participants are usually expected to contribute both cash and labor to a project. However, contributions of agricultural products or materials may substitute in full or part for cash payments, and wealthy individuals have been known to hire others to provide their labor contribution. Some, particularly the poor, do not contribute at all.

Thomas' study shows that the wealthier households in the community make larger cash contributions and assume a greater share of the burden of meeting the costs of the activity than do less-prosperous households. This is substantiated by my own unpublished data. They also provide an amount of labor equivalent to that provided by poorer households. Thus contributions to harambee activities are drawn from across the range of socio-economic variability, with the wealthier bearing a larger share of the burden than the poor. The poorest contributors feel that they benefit from harambee activity to an equal or greater extent than the well-to-do. Non-contributors also benefit, and it is unusual for delinquents to suffer serious conseqences through their failure to participate. Leadership is usually in the hands of local elites, so that the creation of organizational capability is not equitably distributed.

Schools are the commonest type of harambee project, as the government of Kenya has made a commitment to staff and equip schools built by the community, but the real return on education investments is not immediately felt. Nonetheless, in communities with schools, attendance rates among the eligible population may be 90% or more. Water projects which make domestic water available nearby have an immediate benefit for women, and cattle dips which protect animals against disease have permitted the expansion of dairy herds and raised incomes from milk sales.

Harambee projects thus extract inputs of cash and labor proportionately with socio-economic status; distribute benefits equitably; but do not stimulate initiative and organizational capability among less-privileged community members. They build upon the principles of flexibility in group membership, diverse social networks, mobilization of supra-household groups, and exercise of locally-generated initiative. To a certain extent they reflect inequality in that the wealthy can buy off their labor obligation and dominate the leadership, but the broad and equitable distribution of benefits outweighs these disparities. Harambee is easily replicable and similar efforts exist already in Tanzania, Rwanda and elsewhere.

5. Uganda Commodity Import Program (Data from P. Fleuret 1986)

The collapse of Uganda's national-level political and economic structure in the wake of the Amin regime (1971-1979) and the Liberation War (1979) that removed Amin from power prompted a return to basic food crop production on the part of Uganda's small farmers. But even this strategy was threatened by the scarcity of tools and inputs. Most critical of these was the principal agricultural implement, the short handled hoe, then available only on the parallel market at high cost. When development assistance was offered to the post-Amin government, hoes were identified as an immediate need.

USAID responded by importing steel to supply Ugandan factories which manufacture the hoe blades, thus combining industrial rehabilitation with serving the needs of small farmers. In order to overcome problems compounded of scarcity, high price, and corruption (i.e. diversion of the hoes to the parallel market), the Ugandan co-operative movement was selected to manage the distribution of the manufactured blades and their purchase by consumers.

Although agricultural diversity in Uganda was not considered in the project design, utilization of the co-operative structure resulted in a greater supply of hoes being delivered to annual cropping areas where greater need exists because of seasonally-created peaks in labor demand. "That the hoe allocations aligned themselves roughly with agricultural needs was due primarily to co-operative officials and agricultural staff at the district level, who...were able to translate agricultural needs into allocative decisions" (1986:11).

A variety of household-level factors also influenced the process of hoe allocation at various distribution points. Men were the principal purchasers of the hoes, but in at least one locality women formed a separate pool of purchasers; this was in a place where many women had been widowed during the war and hence could not obtain access to a hoe through a spouse. In some places, adults with large households received two hoes while smaller units received just one, or men with two wives received two hoes, monogamous husbands only one. At the local level, a wide range of procedures for delivering the hoes to consumers was developed. As P. Fleuret notes (1986:16), "This impressive systemic flexibility was achieved in part because local leaders had considerable decision-making authority...." Whether deliberately or not, the project allowed local initiative and participation, and took account of variations in household structure and composition and in the nature of agricultural production. The result was that low-resource farmers were provided with hoes that they genuinely needed, through a competent and flexible system of distribution, in a timely manner and at reasonable cost.

6. The Volta Valley Authority (Data from McMillan 1984)

The AVV is a large-scale, planned resettlement scheme carried out in conjunction with onchocerciasis control along the Volta River. The project is capital-intensive and employs centralized planning and a comprehensive agricultural extension program in support of input packages and technological innovations for grain production.

In their home areas, the settlers had jointly farmed part of the land controlled by household members as a unit, but married men and women associated with a particular household also farmed separate portions of the land as private individuals. They had sole rights to the harvest from these individually-cultivated plots for personal use. Some of the produce was sold and money used to meet individual needs, to purchase consumer goods and livestock, and to invest in off-farm activities such as trade and brewing.

The design of the AVV did not take this tradition of private cultivation into account. Five years after resettlement most households had reinstituted private fields, but they were much smaller and the income generated from them much less than prior to resettlement. This was in part due to the heavy labor demands required to cultivate the official AVV plots and to a reduced need for individual production to supplement joint-food production.

Although individual productive activities were considerably reduced in the process of resettlement, independent production still provided cash for the purchase of livestock, jewellery, clothes, and gifts, and for travelling expenses.

McMillan notes that an important lesson of this development experience is that "...a single household may function as a series of overlapping, semi-independent units of grain production, consumption, and marketing. This includes the subdivision of household land, management decisions, and labor between private and cooperative production" (p. vii). Project design and policy must consider such issues as independent production, intra-household organization, and the relationships of various household members at different stages in the domestic cycle. In the AVV, flexibility and autonomy of household members was compromised by the design of an introduced agricultural intervention. This is an altogether too-frequent outcome of the large-scale project, especially one involving resettlement, where social analysis is inadequately incorporated into project design. Such compromises to household productive activity can clearly be avoided in properly-designed projects, ones incorporating beneficiary input as well as the insights of social analysis.

7. National Potato Research Program, Rwanda (Data from Haugerud 1986)

The National Potato Research Program in Rwanda is supported by the International Potato Center (CIP), part of the CGIAR network. The emphasis of the program is on selection and release of improved potato (Solanum tuberosum) varieties which are high-yielding, disease-resistant, and input-independent. The only purchase required of farmers is of the seed itself, which needs to be renewed only every five to ten years. During its first five years the Rwandan program selected and made available six varieties which have yields at least twice the national average. Varieties are selected on the basis of on-station and on-farm trials, initially in the northern volcanic regions most favorable to potatoes, later throughout the country. Social science research supported by CIP and the Rockefeller Foundation is also a part of the program. This research has solicited farmer perspectives and input on such issues as desired potato cultivar traits, intercropping practices, and household dynamics. The data have been used in breeding, variety selection, and seed production programs, to ensure that the criteria used in breeding and selection actually reflect the farmer's situation and needs.

Haugerud notes that "Given the small size, limited resources, and youth of the Rwandan potato research program, it has achieved a remarkable impact" (1986:9). For example, two varieties released in 1980 have already diffused to all of the major potato areas of the country. Given Rwanda's situation of severe land shortage and rapidly growing population, increased yields on the same land area are essential. The existing Rwandan staple food, the sweet potato, is extremely low in protein, a deficiency which can also be redressed by increased Solanum potato production.

The major shortcoming of the program is in the distribution of planting materials. PNAP breeds and selects the varieties, but multiplication of the seed is carried out by a parastatal organization and several rural development projects; these projects then sell the seed to farmers. This cumbersome system has denied many farmers acccess to the new varieties. A second problem is that relatively few varieties have become widely distributed, leading to concerns about genetic uniformity and reduced cultivar diversity.

This program nonetheless incorporates principles of local input and participation, in that farmer's wants and needs feed directly into breeding and selection programs; flexibility, in that the potato seed is the only necessary input to achieving greatly increased yields; situational decision-making, because everything is left up to the individual farmer; risk management, through indigenous experimentation, intercropping, and attempts to maintain diversity.

IV.A. Principles, concepts and development goals

The principles and concepts of productive human resource systems discussed in the preceding sections lay stress on the flexibility, complementarity, and diversity of the social and economic aspects of rural African life. These broad characteristics are integral to the achievement of OTA's goals of development.

The close link between diversity in the cropping system and the employment sector, and maintaining or improving health and nutritional status, is well-documented. Decreasing crop and dietary diversity is associated with poor nutrient intakes and poor nutritional status, especially in young children (P. and A. Fleuret 1980a). A recent finding is an association between children's nutritional status and mother's employment or control of disposable income (Tripp 1981, Hitchings 1982, Carloni 1983, A. Fleuret n.d.). Independently of total household income or socio-economic status, children in households headed by women and/or where women control income seem to be better-nourished than in other households. Projects such as SEMRY, which increase women's incomes, or creation of rural employment opprtunities that do not disrupt existing labor allocation and mobilization patterns, have the potential to raise incomes and improve health and nutrition indicators.

Existing data point to time constraints on women as one of the principal barriers to full and regular utilization of existing health services and facilities. Demands on women's labor thus have a direct effect on their capacity to use available resources for improving health. Building on local institutions such as women's groups, indigenous mechanisms of co-operation, and communities to create labor-sharing or child-care opportunities, or on harambee to provide facilities at less opportunity cost, are additional potential means of furthering these goals of development that are consonant with the principles of social organization.

Reduction of vulnerability and the maintenance or improvement of existing resources go hand in hand. Again, diversity in the cropping system, indigenous agricultural experimentation and innovation, and highly adaptable patterns of land and labor use and allocation are central to the achievement of these goals. Traditional strategies of risk management have been criticized for being conservative, but in the absence of other forms of insurance they are also essential to the viability of farming systems. Low resource farmers have already developed plot dispersal, intercropping and staggered planting to reduce their vulnerability and risks; in the contemporary situation this is augmented and diversified by a multitude of off- and non-farm income generating strategies. Studies have shown (e.g. A. Fleuret 1985) that in years of partial or complete crop failure diversification of non-farm activity permits households to survive intact until farming is again possible. Since in some areas one year in three is marked by some degree of farming failure, the importance of non-agricultural employment as an integral part of the small farmer's regular inventory of activities cannot be overstated.

The promotion of "minor" crops and the conservation of wild food and other plants are important in this regard. There are many local species or varieties of food plants about which little is known. There is considerable evidence that such crops and wild foods are important sources of micro-nutrients as well as being uniquely adapted to local environmental circumstances. Although a cereal such as maize or sorghum may provide over half the calories in African diets, the minor sources of calories and other nutrients can make the difference between an inadequate dietary intake and an adequate one.

Economic and environmental sustainability are to a great degree dependent on controlling population growth, an objective which has not yet met with much success in Africa. There are enough reports (Richards 1983, Stromgaard 1985) of declining soil fertility, reduced yields, shortened or non-existent fallow periods, and staple food crop shifts (e.g. from maize or millet to cassava, viz. P. and A. Fleuret 1980b, Tembo and Phiri 1986) to make the survival of certain farming systems in some localities a real question. The issues of off- and non-farm employment, particularly in the rural sector, again become relevant here. For many low-resource farmers the farm no longer satisfies even food needs, if indeed it ever did. Non-agricultural employment is clearly vital to the economic survival of smallholder households.

Improving the quantity and quality of agricultural production is directly dependent on removing or modifying labor constraints and on reducing difficulties in crop marketing systems. It is unfortunate that removal of marketing constraints runs directly counter to official policies is many African countries. The imposition of consumer and producer price controls and the designation of sole purchasing agents for both food and commercial crops has much to do with the need to keep urban food prices low. In many cases food imports received on concessional terms have been part of this strategy. There is in many cases a direct conflict between the needs of rural producer and urban consumer and too often it is the urban population who benefits from these policies. Urban riots in Sudan and Tunisia have recently prevented implementation of price increases for basic food items.

Unfair pricing policies are not the only marketing constraints involved, because poor roads, inadequate transport capacity, isolation, and inadequte or inaccurate market information can also affect farmer's deicsions about what and how much to grow. In Tanzania, a major disincentive to increased agricultural production is said to be not poor markets for the produce, but lack of markets in which to spend the returns to production. Tax policies which divert the bulk of proceeds from export crops to the state or other institutions rather than the producer also do nothing to encourage production increases. Most of these constraints are institutional, introduced above the level of rural social and economic systems, stifling local initiative. But there is ample evidence that households and communities have the capacity to respond positively given the right incentives and opportunities.

IV.B. Principles and concepts: implications for development agencies

Flexibility, autonomy, and the disaggregation of decision-making are themes that have been stressed throughout my discussion. There are important implications for the design of development projects and the delivery of development assistance in this, which might be succintctly put as, Less is more; or, the complexity and capital intensiveness of a project are inversely related to unequivocal delivery of benefits to rural Africans.

Anthropologists generally take the view that cultural and social institutions are adaptive; that they are the consequence of a long process of interaction between people and environment and function to permit people to manage that environment to their best advantage. Such institutions are also adaptive in that they accomodate change by themselves adapting to deal with new sets of circumstances. "Farmer conservatism" as a barrier to development is a myth; the capacity of African farmers to adjust to changing circumstances is well-documented. The built-in flexibility of social organization, land use, labor mobilization and income generation permits response to incentives and innovations so long as perceived, demonstrated benefits outweigh risks. With projects that are large, heavily funded, or made up of many components, or that require significant changes in land-use patterns, household organization, or labor organization, benefts may not be readily apparent, or from the farmer's viewpoint may be non-existent. Interventions should not seek to alter the structure of rural society so much as to increase the range of options open to the low resource farmer. P. Fleuret, in his review of agricultural assistance in Africa, recommends simplification and streamlining of projects, together with more non-project assistance (1985). Fortmann, in her study of benefits to women from AID agriculture projects, found a strong relationship between project success and the factors of low cost, small scale, and long term.

The examples of successful projects described in Part III of the paper all permit or require autonomous decision-making on the part of individuals, households or communities. Even the highly-capitalized and deterministic SEMRY I project leaves the arena of labor allocation in the hands of household members. The organization of rice work and the division of profits between spouse favors men but nonetheless rewards wives at a higher rate than other available economic activities. In harambee, choice and initiative are exercised at the community level rather than imposed from above. The decision to buy hybrid maize seed is made by the farmer him or herself, and production can be undertaken without any additional costs or associated inputs. The seed is not part of a complex, expensive, high-risk technical package. Conversely, in the AVV, massive donor investment, and resettlement, created a farming system with increased labor demands that reduced the individual's capacity to farm on his own behalf and obtain personal income.

The major implication, then, is that thinking about development should be oriented away from the large, expensive, multi-facted project and reoriented in the direction that many private voluntary organizations already endorse: community-level, low-capital, participatory development. The National Christian Council of Kenya's program of promoting rural enterprise development by making credit available in very small amounts through women's groups, to the group as a whole or to individual members, is a case in point. PVOs have also been instrumental in facilitating harambee projects by helping to organize labor and providing materials and technical assistance (e.g. for engineering water projects).

Following on this is the implication that assistance should not be limited to the agricultural sphere. Many low resource farmers are unable to produce enough food for their own consumption with existing land and labor resources; they must combine farming with some other income-generating activity or activities. These off- and non-farm occupations are an integral part of individual and household strategies. What farmers need besides appropriate agricultural interventions (removing market constraints, improving infrastructure, increasing the range of available inputs, improving crop varieties) are programs that expand their options in education and employment, particularly the latter.

The importance of research to inform agencies about significant socio-economic factors and institutions in a project or program area has already been mentioned, but not stressed. Fortmann (1985) attributes the failure of a multi-million dollar agricultural project in Zaire to, among other things, complete ignorance about the cropping system, labor patterns, and household dynamics in the area. On the other hand, success of projects has been linked to building socio-economic knowledge into implementation (e.g. the Kitui project cited by Carloni, 1985:7, and the Malawi WID project cited above as case study 3), or by building fexibility into community-level aspects of program management to accomodate social organizational variables (Uganda commodity import, case study 5 above).

Often the impact of a project on local social and economic institutions simply cannot be predicted. Thus, if these institutions are to continue to function, and if the project is to have a positive impact, on-going monitoring of development activity is essential. Project design should be sufficiently flexible to permit changes in implementation if monitoring shows unfavorable impact could be eliminated or chances of success enhanced by changes in the project.

Impediments to the implementation of development assistance in accordance with these principles clearly exist. Although, for example, a social soundness analaysis is required for all AID-funded projects, this is often a pro forma exercise which receives fleeting attention. But, carrying out a detailed social analysis or conducting social research adds to costs, delays implementation and lengthens project duration. Monitoring also adds costs, consumes time, adds personnel and adds to the work burden of project managers. Small, cheap, long-term projects are not popular at least in part because results take longer to obtain and because the multiplication of projects requires more oversight for the same amount of assistance dollars spent. Time is more efficiently allocated dealing with a few large projects rather than many small ones.

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Appendix 1. Integration of principles and concepts to achieve development goals

Natural, human and institutional systems cannot be totally separated. Institutions are cultural products, created by people; natural resources are managed and utilized by people; and to a greater or lesser degree the environment, consisting of both natural and cultural components, constrains the nature of human adaptation and exploitation. The linkages between these systems are fundamental. None of the authors has been able to discuss any one of the systems without reference to the other two.

Given the linkages between natural, human, and institutional systems, it is not surprising to find that a number of common themes are stressed in the principles and concepts that provide the basis for each paper. All of the authors identify flexibility, diversity, and local participation, initiative, and knowledge as essential to furthering development among low resource farmers. In addition, the importance of a thorough understanding of the environmental, social and institutional setting prior to introduction of innovations or project implementation, as well as on-going monitoring of development activities and project modification as more is learned about local circumstances, is stressed in each paper.

Flexibility is a critical element in social organization, permitting multiple strategies of access to land, labor and income. Likewise, multiple institutional channels, from the central bureaucracy to the local institution, together with the vertical and horizontal linkages between different kinds and scales of institutions, provides a flexible framework and increases the range of choices open to individuals and groups. In the management of natural resources too, flexibility is important; strategies of herd movement among pastoralists in response to environmental variables, and farmer responses to environmental risk, such as plot dispersal and intercropping, demonstrate also the importance of the capacity to respond differentially in ways appropriate to the variability and dynamism of rural life, as well as the diversity of the natural environment.

Diversity is particularly stressed in the paper on natural resource systems. Economic, ecologic and genetic diversity are identified as critical components of a viable program for increasing agricultural productivity, managing risk, and ensuring sustainability. In the area of human systems, diversification at household, local and regional levels, in agricultural activity, social networks, and income generation, expands the concept of risk management beyond the farm. The significance of diversity becomes even greater when multiple institutions, individually or as an interconnected framework, provide further opportunities for farmers to insure against risk and increase their range of choices.

Local participation and initiative is a third theme which is emphasized in all the papers. To a certain extent peoples' decisions and choices are constrained by institutional factors and by the quality and quantity of available resources, but many decisions about agricultural strategies, labor deployment, and income generating activity are made at the individual or household level. Development planning clearly must take the local and individual nature of such decision-making into account. Institutions too must respond to locally-generated and locally-identified demands and needs; local membership institutions, as defined by Milton Esman, play a critical role in rural development. Although organizations or groups are probably more effective in communicating local needs to higher institutional levels or to donors, we must not lose sight of the fact that not all institutions are organizations. Co-operative labor is an institution which is organized situationally; the fact that it does not exist as a specific, concrete organization at all times should not preclude it from having a place in an institutional network or framework. The same is true of seasonal organizations, such as those which manage water or other resources which are available only at particular times of the year.

The paper on natural resource systems calls specifically for the participation of local people throughout the development process, and points to the importance of local knowledge, local crop varieties, and situationally-specific cultural practices in the sustainability of low-resource farming. It is important to stress yet again that African farmers are not inherently conservative or necessarily constrained by tradition from adopting innovations. If unequivocal benefits can be demonstrated at the same time that risk can be managed, adoption will follow. Hybrid maize adoption in Kenya and Solanum potato cultivation in Rwanda are excellent illustrations of this argument. But local practices are often maintained at the same time that innovations are adopted, because long experience under the sorts of constraints experienced by the low-resource farmer has taught him or her that particular farming strategies are more likely to result in a harvest than others. It is not the fetters of tradition that guide decision-making, but the necessity of producing food under well-understood local conditions. Hence the necessity of building, to the greatest extent possible, on existing knowledge and practices, and creating development situations that permit the farmer, as individual, householder, or local group member, to take the initiative.

Local knowledge and local initiative are significant not only from the perspective of the beneficiary of development but in the context of development planning as well. All three papers again stress the importance of a thorough understanding of social, institutional and natural systems prior to the implementation of a project. The assumption that development projects can be rationally designed in the abstract to take into account the diversity and flexibility which exist in the real world is being questioned. Rahter than a "blueprint" approach based on detailed planning, what may be better is a "learning process" approach in which projects are designed with an initial period of flexible implementation during which personnel can become aware of critical aspects of the natural, social and institutional environments. Only actual experience will tell what elements are important; this serves as a guide to subsequent project activities. And since people, institutions, and environment are not static, monitoring of development activity to permit, as Esman notes, "expedient adjustment to local variations" in the course of development activity, is essential.

Appendix 2. Revisions to "Principles and Concepts of Productive Human Resource Systems"

1. Application of integrated principles and concepts

Both in the scholarly literature and in the practices of major donors, guiding theories of change and development have been based on a Westernization model. The key assumption is that developing countries and their people want and should alter their ways of living in the direction of Western nations and people, and that Western practices are progressive, positive and beneficial as opposed to conservative, primitive and traditional. In agriculture, this has led to an emphasis on such farming policies as genetic uniformity, single cropping, mechanization, and chemical inputs such as fertilizers and pesticides. Application of the integrated principles and concepts clearly requires some modification of prevailing assumptions and practices, because these principles eschew rigidly Western agricultural models and policies in favor of diversity, risk management, flexibility, and local initiative and participation. Development based on these principles requires planning and implementation quite different from that necessary for the replication of Western agriculture. The following would need to be addressed:

a. beneficiaries' concerns, especially through their identification of their main agricultural and other problems and the constraints under which they operate;

b. the kinds of institutions, especially local institutions, that already exist and which could be used as pre-existing channels for development assistance, and the linkages between these institutions;

c. the role of the farming system in the total economic system, taking into account seasonality, off- and non-farm forms of employment, and variability by gender;

d. Existing constraints to innovation adoption such as shortages of time and/or money, conditions of risk, seasonal or constant labor shortages, etc.

2. LRA-specificity

My paper was prepared with the low-resource farmer specifically in mind. However, given the OTA definitions of LRA and LR farmers, there are relatively few African farmers who are not low-resource farmers. In Kenya, for example, over 90% of the rural population consists of smallholders possessing less than 8 ha of land. 75% of all smallholdings are less than 2 ha in size. Large farmers with holdings of 20 ha or more make up less than 1% of the rural population. Only these latter can be expected regularly to use mechanical cultivation, commercial fertilizers and other external inputs. Studies cited in the main report demonstrate that even where tenure and agrarian reforms have been implemented and where "economic" holdings have been created, farmers continue to use the concepts and practices of LRA. While most African countries have a large farm sector, the numbers and percentages of farmers in this non-LRA category are very small, as in Kenya. Despite the effects of rural stratification and differentiation, most African farmers continue to conduct some or all of their farm operations according to the principles of LRA, although they may at the same time use external inputs and information to the extent that their resources permit. The only principle that is almost certainly not operative in the large farm sector is #7, flexibility in land tenure/access arrangements. Otherwise the stated principles hold true for African-operated large farms as well as small holdings: household flexibility, gender complementarity, local initiative, resource diversity, multiple income streams, and off- and non-farm income sources.

3. Western vs. African household models

The prevailing Western model, especially as employed by economists, assumes a monogamous, nuclear, two-generation unit, whose members have common goals, where decisions are made jointly or by one member (usually an adult male) acting for the members, where income is pooled, where individual activity is subordinated to the common good, and where men are income earners and women are housewives. That this model no longer approximates reality in the West goes without saying. It has never applied in Africa, where households may be polygynous or extended by incorporation of additional generations, married couples, or other kin or non-kin, where members have diverse goals and multiple strategies for achieving them, where decision-making is often individual, autonomous and independent, where income probably is not pooled, and where women are housewives as well as farmers, income earners, managers, decision-makers and heads.

A number of studies show that if it is assumed that males are household heads who make all decisions and manage income, development assistance will be targeted to those males. If agricultural development calling for commercial production is implemented, participants will be exclusively male. They receive the training, credit, inputs and extension advice, and expropriate the labor of their wives and daughters to service the crop. Several negative effects are immediately introduced. The labor of these women is subtracted from food production and household food availability declines accordingly; this female labor is undercompensated, further compromising household security; and those households without resident adult males are totally omitted from participating in and potentially benefitting from agricultural development. These effects are well-documented. Christine Jones in particular urges the abondonment of a Western household model in favor of a bargaining model which explicitly recognizes the complementary and competitive, as well as common, goals, objectives and activities of household members.

4. LRA and off-farm income

The role of LRA in household maintenance strategies which also rely on non-farm income can be illustrated by my own research among the Taita of southeastern Kenya. Every household I have studied (over 400) has access to one or more of the following sources of non-farm cash income: local permanent wage labor, local casual wage labor, migratory wage labor, self-employment in a skilled trade (e.g. carpentry) or commerce, production and/or sale of non-farm goods such as charcoal, honey, handicrafts. Actual cash income over the course of a year varies widely, from a low of about $250 to a high of several thousand dollars. In the lower-income households as much as 80% of this cash income earned may be spent on food and fuel. There are many essential foodstuffs which cannot be produced on the farm (tea leaves, sugar, cooking fat, wheat flour). Cash is also necessary for purchasing clothing, household implements and utensils, and agricultural inputs, paying school and clinic fees, and making harambee contributions.

The annual value of food produced and consumed by household members is at least $350. Such production is the source of most of the calories and other nutrients consumed by household members. In the poorest households the cash income is not large enough to replace home production with purchased foods. In the more well-to-do households--usually those of labor migrants--the food produced largely feeds household members while cash income in excess of the amount required for domestic maintenance is used for other purposes, such as purchasing land or livestock, improving the house, investing in a small business, or hiring labor. In any case food production is clearly the cornerstone of the household economy, consumes the bulk of labor, and provisions the unit so that available cash can be used for vital food and non-food purchases.

5. How to get resources into women's hands

a. Land. Creation of consolidated holdings registered in the names of adult males should be discouraged. Female household heads should be equally able to acquire holdings on settlement schemes. Widows should be able to inherit land from their deceased husbands (under both customary and modern law widows frequently are not heirs). Divorced women should be assured access to land through parents or former spouses.

b. Cash/credit. Loan/credit programs should target women, both female household heads and women with co-resident spouses. This could be done through such institutions as womens groups and churches. Buying points should be established for all agricultural products at accessible local rural markets. Co-operative membership or ownership of certain quantitites of land should not be made necessary conditions for receiving credit. Continuation of informal rural savings/credit groups should be promoted by creating regulations for prosecution of defaulters.

c. Inputs. Agricultural inputs should be delivered through womens' groups, churches, schools, marketplaces, commercial outlets. They should be freely and independently available for cash instead of requiring co-operative membership or adoption of complex and untried technical packages.

d. Institutions. Extension services should target womens' groups and should offer information not just on agricultural topics but on institutional channels and ways of securing credit and inputs. Adult literacy campaigns should be supported, as women are more likely to be illiterate than men. Co-op membership must be fully open to women and minimum percentages of officers should be female.

e. local initiative. Harambee or similar activities should be initiated and inmplemented by such organizations as women's groups or churches.

f. time constraints. Women should be provided with more time to take advantage of existing or newly-created opportunities by making potable water, village woodlots, village health workers and nursery schools or day-care facilities top priorities.

6. Successful case studies

The successful development activities reach large numbers of people of both sexes at low cost in ways that permit sustainable increases in production and ultimately in well-being. Harambee, Rwanda potato improvement, Uganda commodities, Kitale maize and Malawi WID all conform to this concept of success. All but the Uganda commodities project are replicable. The model of harambee has been widely used in Tanzania and Rwanda as well as Kenya. The Kenyan hybrid maize and Rwandan potato programs have provided improved varieties which can be used by farmers to increase their yields, improve their diet, and increase their income at low investment levels and without purchase of other inputs. Given the numbers and situation of women farmers in other countries, the Malawi WID project is a model wich should be implemented elsewhere. Further, each of the projects described exemplifies a number of the principles and concepts. The two projects described which contravene the principles or which act upon relatively fewer of them only are accordingly less effective in delivering benefits to farmers. Kitale maize and PNAP are frequently cited as successful programs both within and outside of development agencies.

7. Stratification. Inserted into text.

8. Implementation according to principles and concepts. Inserted into text.

9. Successful agricultural development and flexibility.

Both the Kitale maize and PNAP case studies are examples of successful agricultural development that utilizes existing flexibility. In both cases a single input--hybrid maize seed, or improved Solanum potato cultivars--is made available. In Kenya individual farmers purchase their seed through co-operatives or at retail outlets. In mid-1985 one 10 kg bag of hybrid seed cost about $5, and contained more seed than the typical Taita farmer could plant, so farmers often purchased a sack on shares. This ensured that even those without cash could obtain seed by going shares with neighbors or relatives and paying them back later. No other inputs are required, although those who can afford them will buy fertilizer and pesticides and boost their yields even further. But even without these other inputs, so long as rainfall is adequate, hybrid outproduces indigenous maize 2 to 1. Improved cultural practices would also boost yields, but the fact remains that for a minor investment--less than 1% of gross household income even in the poorest households--and a minor increase in risk, the farmer can potentially double his maize harvest. All Taita farmers who plant hybrid continue to plant indigenous varieties as well, as risk insurance, but even partial planting with hybrid increases yields without additional input or labor costs. Everything about the farming system, the allocation of laobr, and land use practices, remains as is except the point of origin of the seed planted. The same is true of the Rwandan potato program, except that rather than making yearly seed purchases, Rwandan farmers need make new purchases of planting material only after five to ten years. Without any additional inputs, the improved potato cultivars yield two to five times the national average.

A comparison of commercial cotton and vegetable farmers in the Taita Hills provides another example. The cotton project was a highly structured, deterministic program dependent on external funds, inputs and labor. Late releases of funds, heavy charges for inputs, unavailability of contract plowing, shortages of labor for weeding, and low prices offered by the only legal buyer were some of the program elements that discouraged the cotton growers. Simultaneously, vegetable production organized along traditional lines flourished. Multiple channels for acquisition of inputs and sale of commodities coupled with flexibility in land use, timing of planting, cultivation techniques, selection of varieties, labor recruitment and deployment, and disposition of the products characterized the vegetable system; both participation and returns to the grower are high, cost and risk low.

These are not the only examples of how existing institutions possess sufficient adaptability to permit positive and profitable responses to development inputs. They also support the argument that the more highly-structured the program, the less likely that the vitality of local social and institutional organization will result in positive outcomes for the farmer.

10. Revised list of principles and concepts

A. Principle 13 from the original list was agreed at the workshop to be subsumed under 12. 14 belongs under integrated principle H. I am not certain that 19 and 27 belong here.

B. 35 is questionable for inclusion here, but 26 and 27 definitely belong, as well as 19.

C. I agree.

D. I do not feel that 14 and 19 belong here, and 27 is questionable.

E. 24, 26 and 27 are questionable; 28 should be included; in my revisions, I have deleted 39 as a principle/concept but have retained the relevant discussion in the text (pp. 33-35).

F. I agree.

G. 14 is not appropriate here, but 36 and 37 should perhaps be included as they are in my analysis integral to the viability of agriculture.

H. 14 belongs here; 41 possibly.

Contract Paper No. 4

DRAFT

PRINCIPLES AND CONCEPTS OF EFFECTIVE INSTITUTIONS

by

Milton Esman
Cornell University

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May 1986

DRAFT

3/10/86

Low-Resource Agriculture in Developing Countries: Implications for Africa
WORK STATEMENT

Title: Low-Resource Agriculture in Sub-Saharan Africa:
Principles and Concepts of Effective Institutions

I. Background Information

OTA is commissioning information from three authors on the principles and concepts for 1) natural resource management, 2) effective institutions, and 3) productive human resource systems. We have chosen these areas in order to emphasize each in a manageable way. We recognize that the distinction between human and institutional resources can be unclear. As OTA uses these terms, "human resource system" means social units such as households, groups, villages and communities with which low-resource agriculturalists have direct contact. The "institutional resource system" means the formal organizations, such as government agencies, private voluntary groups, etc., which serve functions such as research, training, and extension and which deal with broader economic, social and political environments.

Each author's written material should focus primarily on the one assigned resource system. OTA will conduct a workshop for the authors and other participants to discuss how management of the three types of resource systems can be integrated.

A. Definitions and Characterizations

The author will use these definitions and characterizations:

1) Low-Resource Agriculture: Agricultural systems used by poor, small-scale farmers and herders that rely principally on local inputs in order to support household activities. While these systems are diverse, they generally share certain important characteristics, such as being:

- low-risk rather than high-yield
- low-cost
- dependent upon local knowledge
- dependent upon biological processes and renewable resources
- adapted to local environments and cultures
- dynamic and experimental within constraints imposed by risks
- diversified

2) Low-Resource Agriculturalists: A heterogeneous group of rural people who generally are poor and who have limited access to and control over land, water, labor, capital, external sources of information and technology, and external inputs such as commercial fertilizer.

B. Assumptions

The author will undertake this work with the following assumptions or will consult with OTA before using others.

1) Many people consider low-resource agriculture as the problem that prevents increasing food production in Africa. Instead we consider it both a problem, since low-resource agriculturalists are poor, and a solution, since solutions must match existing conditions. Therefore we will build upon existing opportunities instead of focusing only on removing constraints.

2) Food and livestock production is a major activity of low-resource agriculturalists but they may also engage in cash crop production, fish-farming, forestry, and food processing and marketing. While the focus of this study is on Africa, we expect to examine technologies and policies in a broader context of the developing world and United States' agricultural interests.

C. Goals of Development

The author will accept that low-resource agriculturalists in Africa should themselves determine their development goals and that their strategies will be varied. Effective and appropriate U.S. goals to assist them are:

1) to increase people's quality of life, e.g., reduce drudgery, expand choices, increase income and employment, and improve health and nutrition.
2) to reduce vulnerability.
3) to maintain, build upon, and improve indigenous resources and systems.
4) to ensure economic and environmental sustainability.
5) to improve the quantity and quality of agricultural production.
6) to remove or reduce production, marketing, storage, and processing bottlenecks.

II. Specific Responsibilities of the Author

A. The author will take part in a one-day meeting at OTA on March 19, 1986 to discuss, with several other contractors and OTA staff, the contents of this work.

B. The author will prepare written material acceptable to OTA by May 1, 1986. This material will not exceed 65 pages; material that exceeds this limit is not acceptable to OTA and does not fulfill this contract. This material will include:

1) a brief, 1-2 page list of principles and concepts that apply to effective institutions in low-resource agriculture in sub-Saharan Africa. This list should summarize and accompany a 5-page commentary describing the principles and concepts. In the commentary, the author should note other experts' ideas and identify key literature on the subject but this section is not meant to be exhaustive.

2) a discussion of how these principles and concepts have been and can be applied to development in sub-Saharan Africa. This discussion should emphasize practices/processes (see suggested contents), e.g., ensuring local participation, and:

   a. include the technical aspects of application, e.g., planners must have field experience.

   b. include the institutional aspects of application, e.g., performance criteria should reward extension workers' efforts to link farmers and researchers.

   c. identify constraints to application, e.g., overcoming urban bias of planners.

   d. consider how ecological and social diversity might affect applications, e.g., examine how applications might differ in arid vs. humid regions, or in pastoral vs. sedentary societies.

   OTA and the author agree that he will discuss alternatives to bureaucratic institutions, improvements to and reorganization of existing bureaucracies, enhancement of participatory organizations, and links among local, regional, and national institutions.

   The author will illustrate the applications included in this section with examples, not necessarily from Africa. This section should be no more than 30 pages long.

3) an appendix of 5-8 brief (1-2 page each) African case studies illustrating the applications discussed above. Are these examples replicable? Why and how have they worked or not worked?

4) a brief discussion (no more than 5 pages each) of:

- o How would application of the author's principles and concepts for effective institutions affect the six goals of development set out above. What conflicts arise: what trade-offs are necessary?

- o How could different development assistance organizations, e.g., AID, PVO's, effectively apply the author's principles and concepts for effective institutions? What impediments exist?

5) an institutional typology that sets out, in a table, the characteristics of institutions discussed. (approximately 2 pages)

C. The author will take part in a 2-day workshop at OTA during June, 1986, to integrate the author's material with that of the two companion papers. This meeting will produce Congressional options for encouraging such integration, e.g., by passing new legislation, changing appropriations, carrying out oversight, etc.

OTA will circulate all authors' contributions to this author during May, 1986 and:

- o the author will address briefly (no more than 5 page) how the principles and concepts for managing effective institutions can be integrated with those for managing natural resource systems and for productive human systems in order to achieve our development goals. This material will be submitted to OTA by June 1, 1986.

D. The author's work will be reviewed by the assessment's Advisory Panel and other peers and the author will respond to comments and revise material as needed. This review will take place prior to the meeting of the June working group, with revisions due one month after the meeting.

- o The author will provide, with other written material submitted by May 1, 1986, the names and affiliations of three potential reviewers.

III. Format for Written Materials

A. All written materials will be submitted typed double-spaced on 8 1/2 by 11 inch papers.

B. If possible, these materials may also be submitted via IBM-compatible disk or via modem to OTA's IBM or NBI system.

C. A complete list of literature cited will be included, following the examples attached.

D. Literature referenced within the text will be cited as (Author, year).

E. Information attributed to personal communications will be cited as (Name, pers. comm., date). These names will be included in the list of literature cited, with the communicant's affiliation, and address.

F. The use of footnotes is optional but, if used, they should be submitted separately at the end of the relevant material.

G. If acronyms and technical language are used, they will be defined in the text and a list of acronyms and glossary included.

H. Photographs, slides, or other types of illustrations will be included with the delivered material if available. A numbered list of these will be included with the written material.

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of effective institutions

- A. Ensure wise use and development of human resources (e.g., technical skills, attitudes, numbers of people) to serve low-resource agriculturalists

- B. Ensure wise use and development of capital and other assets (e.g., money, infrastructure, inputs, knowledge, policies, procedures) to serve low-resource agriculturalists

- C. Develop ability and accountability to sustain development process for low-resource agriculturalists

- D. Develop capability for flexibility: adaptability to cultural context; capacity for institutional learning; development of a diversity of strategies to deal with diversity of needs

- E. Use criteria for selection, development, and diffusion of technologies that consider technical efficiency, advantages accruing to the household (e.g., income, reduced drudgery, status) and advantages accruing to society (e.g., income distribution, employment, resource conservation, foreign exchange)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use of and development by institutions of the resources (e.g., labor and capital) that they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use and development of institutional resources (including some examples -- with more detailed examples to be appended as case studies)

- A. Capital and other assets (e.g., procedures)
    1. ensure local participation (i.e.,)
        - a. planners must go out to field
        - b. extension workers must link farmers and researchers
    2. provide timely delivery of money, information, inputs, services, etc.
    3. must allow for problem-solving and not prescriptions
        - a. must address diverse needs of diverse groups
        - b. planning should be iterative process incorporating feedback
        - c. must use and develop management skills (e.g., administrative, priority setting, research management, etc.)

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of natural resource management

A. Increase productivity: measure of output per unit of resource; eg, yield, income

B. Improve quality: defined by its benefits to the humans in the system (nutritional, medicinal, etc)

C. Ensure sustainability: ability of system to allow continued or improved productivity

D. Ensure stability: ability of system to maintain productivity in spite of disturbance (eg, varying rainfall, fluctuations in market prices). Most conveniently measured by the reciprocal of the coefficient of variation in yield or income

E. "Close" the system as much as possible: reduce the loss of resources other than through harvesting

F. Rely on biological processes as much as possible

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices for managing energy use, water use, land use, pest control, and maintenance of genetic diversity . For example:

I. Low-resource agriculture in sub-Saharan Africa: Management practices (including some examples --- with more detailed examples to be appended as case studies)

A. Practices for managing water use:

1. maintain vegetative and/or litter cover to reduce runoff and evaporation

2. maintain soil organic matter to increase infiltration, allowing the soil to act as a sponge absorbing and holding water

3. maximize spatial heterogeneity of roots to minimize leaching

4. use plants and animals adapted to local water regieme

5. use water harvesting and irrigation techniques that use water renewably rather than mining it; e.g.,
    a. diguettes in Burkina Faso (increase infiltration and reduce runoff, thereby increasing productivity and "closing" the system)
    b. etc

Companion Paper on Productive Human Resource Systems

IV. Suggested Paper Contents

I. Low-resource agriculture in sub-Saharan Africa: Principles and concepts of productive human resource systems

- A. Ensure access to, control over, and mobilization of local productive resources
- B. Minimize risk
- C. Blend cultural continuity with change
- D. Match the multiple goals and functions of groups to the actual needs, perceptions, and priorities of individuals
- E. Ensure a functional internal division of labor
- F. Ensure equity through participation in decisions, actions, and benefits affecting individuals and groups (focusing on who and how rather than just numbers in all stages of planning, implementation, evaluation, and benefit sharing of projects and programs)

One possible way to organize the discussion of how the principles and concepts have been and can be applied for development would be to examine practices that ensure the wise use by human systems of the resources (i.e., land, water, labor, and capital) they have at hand. For example:

I. Low-resource agriculture in sub-Saharan Africa: Wise use of resources of human resource systems (including some examples -- with more detailed examples to be appended as case studies)

- A. Labor:
  1. mobilize underutilized and unutilized labor and skills, e.g.
     - a. food for work
     - b. etc.
  2. maximize local employment opportunities
     - a. provide local opportunity for small scale service industries
     - b. provide training and local materials to capitalize on opportunities
  3. maximize productive potential of all members of agricultural labor force
     - a. reduce drudgery
     - b. value unpaid work of members
  4. improve skills through training
     - a. demonstration farms, etc.

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LOW RESOURCE AGRICULTURE IN SUB-SAHARAN AFRICA: PRINCIPLES AND CONCEPTS FOR EFFECTIVE INSTITUTIONS

Milton J. Esman
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I. Guiding Principles and Concepts

1. Multiple institutional channels are available and potentially available to serve low resource farmers. None should enjoy a monopoly, none should be overlooked, and all should be employed where they are most effective.

2. Local institutions, informal as well as formal, responsible and accountable to local publics, constitute a major institutional resource that is indispensible to rural development and should be fostered and facilitated by governments and donors.

3. Different combinations of institutions are required to serve rural publics, depending on their comparative advantages for specific activities. The vertical and horizontal linkages between them form the networks that constitute the institutional infrastructures for agricultural and rural development.

4. Central government bureaucracies must be reformed in their structures and procedures and reoriented in their operations in order to serve low resource farmers.

5. Institutional patterns should emerge from specific local needs, not from central blueprints, and must evolve over time to accommodate technological, social, and economic changes.

6. Institutional choices, structures, and operations must be specifically responsive to the economic roles of rural African women.

7. Because of the prevailing variability and uncertainty in rural Africa, a) affected publics must be consulted, preferably through their own organizations, in the design and implementation of program interventions; b) governments and donors should regard technical and institutional innovations as action hypotheses to be monitored and adjusted in the course of social learning.

II. Commentary on the Guiding Principles

These principles and concepts summarize the current state of the art among informed observers of rural development on the African scene. (Johnson & Clark, 1982; Esman & Uphoff, 1984; Uphoff, 1986) In the body of this paper I shall develop these themes and illustrate them where possible with reference to African experiences.

1. Services to African rural households should be provided by multiple institutions operating through multiple channels. No institution or set of institutions should have a monopoly and none that are potentially useful should be excluded. Various institutions enjoy distinctive capabilities and encounter distinctive limitations depending on the service that is required, the constituency they serve, and the environment in which they function. The prevailing institutional pluralism should be regarded by program designers as an opportunity, not a problem. Given the virtually unlimited needs and the extremely limited institutional capabilities in rural Africa, all potential institutional resources should be facilitated and put to use where they can be most effective. (Uphoff & Esman, 1974) These alternatives include various central government departments and parastatal enterprises, private voluntary agencies, regional and local government entities, foreign and indigenous private firms, and local membership institutions.

2. Local initiatives through local institutions accountable to local publics should be fostered and encouraged. Resources and services provided by governments and foreign donors, though important, will not suffice to meet the development needs of low resource African households. Local initiative and collective self help represent an enormous underutilized potential which has been overlooked where it has not been positively

discouraged by the policies of most African governments. There is an emergent consensus that local institutions can provide capabilities for mobilizing resources, managing common facilities, exchanging information with outsiders, providing services, and making claims on government that cannot be duplicated or substituted by outsiders. They are thus indispensible to improving the productivity and the quality of life among low resource rural households. Assistance to local institutions should be a high priority objective for African governments and for donors. (Esman & Uphoff, 1984; Johnston & Clark, 1982)

How

3. Productive linkages must be facilitated among the various institutions serving rural publics. Only rarely can a single institution successfully carry the burden for any particular service. Their effectiveness depends on the complementarities that can be developed among institutions operating on behalf of the same publics. Depending on the service and on the context, different patterns of linkage can be identified and these form exchange networks, both vertical and horizontal. As they evolve and deepen, these institutional networks provide a more productive infrastructure of development services for rural households. Some of these linkages are likely to include international as well as local, regional, and national level structures. (Uphoff, 1986) Program designers should think in terms of institutional networks rather than single organizations to accomplish programmatic goals.

4. Central governments and their bureaucratic institutions are a major force in serving agriculture everywhere and this will continue to be the case in tropical Africa. But because they are already overloaded, because many of their activities are ineffective, and because rural publics need more services than governments will be able to provide, they should be

encouraged to share this burden with non-governmental institutions. Even as this division of labor proceeds, governments and donors must address the crippling deficiencies of the bureaucratic institutions that serve agriculture. The inherited structures and procedures of most of these implementing agencies and the attitudes and behavior of their management and personnel are serious impediments to performance, especially to their ability to serve low resource households. Reform and reorientation of these bureaucratic institutions are unavoidable necessities. Policy changes and program innovations will be sterile if implementing agencies, especially government bureaucracies, are not able to perform. (Kortan & Uphoff, 1982)

5. In the absence of reliable knowledge about the conditions of African peasants, there has been a tendency for governments--often prodded by foreign donors--to install institutional models drawn from the experience of other continents. Not surprisingly, many of these institutional transplants have functioned poorly and will have to be radically restructured if they are to serve their intended purposes. Sound institutional development begins with the specific needs, preferences, and experience of the publics to be served. Some evolve and adapt spontaneously; frequently they must be complemented by governmental and other outside interventions, but these too should accommodate to local needs, capabilities, and experience. Any intervention must take account of highly institutionalized rights to land, cattle, and even trees. (Fortmann, 1985) As more is learned about African rural life and local production systems, governments and donors should be able to design institutional interventions more responsively. They should be so shaped that a) they permit expedient adjustment to local variations, and b) incorporate sufficient slack so that

they can adjust readily to increasingly dynamic technological and socio-economic environments.

6. African agriculture is heavily dependent on the economic contributions and participation of rural women. This is especially true of small scale, low resource households. The Economic Commission for Africa estimates that 70 percent of the labor involved in growning food crops and 100 percent of the labor in food processing are provided by women. This is not reflected in the composition or the performance of institutions serving rural publics which continue to emphasize women's role as homemakers. Any institutional strategy to upgrade food production must directly address the economic needs of rural women, provide them with realistic access to services, and facilitate their participation. (ILO-World Employment Program, 1985)

7. Those who seek to intervene in African agricultural and rural development encounter high levels of uncertainty. This applies both to the natural environment and to social behavior. Very limited knowledge of how things actually work is aggravated by extreme ecological and cultural variation, by low educational standards, and by the isolation of rural Africa. Institutional choices and program innovations must explicitly incorporate the dimension of uncertainty into their procedures. To compensate for the prevailing levels of uncertainty, it is essential that a) affected publics be involved in the design and implementation of technical and institutional innovations so that accurate information about local conditions and preferences can be available to decision makers, and b) governments and donors treat program interventions as action hypotheses to be monitored and adjusted in the course of social learning. (Rondinelli, 1983; Korten, 1980) Program designers must first attempt through survey

and other methods to learn about the specific natural, social and institutional environments for which interventions are intended and to treat these interventions as technical and social experiments.

III. Discussion and Elaboration

Low resource farmers in Africa comprise the great majority of the labor force. They are responsible and will continue to be responsible for producing most of Africa's food. This paper deals with the institutions that can help them to increase their economic productivity, enhance their security, and improve their well-being and quality of life.

For most rural Africans, the household is the relevant economic unit. Land holdings are small and likely to diminish with population growth and the exhaustion of the land frontier. Most households cultivate fragile soils and cannot afford chemical fertilizers or pesticides. In the absence of irrigation, 97 percent of African farmers depend on uneven and erratic rainfall. Many villages are physically isolated and hard to reach, especially during rainy seasons. Most small farmers practice mixed cropping and livestock raising; producing primarily for household subsistence, they also attempt to earn some cash income by marketing their surpluses. All members of the household above the age of ten are active economically. Especially where adult males migrate in search of cash earning, a substantial proportion of household income is earned off the farm and much of the farming is done by women. Patterns of socio-economic stratification are emerging. A small group of relatively prosperous farmers enjoy good connections with government institutions and commercial networks; the mass of semi-subsistence small holders have few institutional links and little capacity to influence government; at the bottom the growing stratum of landless agricultural laborers have virtually no institutional support. Everywhere rural people are migrating in large numbers in search of better economic opportunities, some seasonally, some permanently, to urban areas, to commercial plantations, and often across international borders. These processes are occurring both among sedentary cultivators and among the 15% or so of African rural households that are primarily pastoralists.

Governments are a major factor in Africa and with few exceptions they have neglected rural development. The image of "modernization" that dominated economic and social thought at the time of independence a quarter century ago assigned priority to industrialization, large scale commercial agriculture, and urban infrastructure. Government planners and donors believed that a rapidly expanding modern sector would gradually absorb surplus labor from backward peasant agriculture which in turn would eventually be modernized by mechanization. This development strategy which contributed to the neglect of peasant agriculture has died hard. Moreover, the desire of central government elites to consolidate their regimes by penetrating the rural peripheries and neutralizing centrifugal regional and ethnic influences has resulted in policies that discourage local initiatives and monopolize revenues in the hands of the central government.

The food crisis of the past decade, combined with increasing demands for public services, have induced some governments to revise their strategies in favor of rural development. But except for services to commercial agriculture which earns foreign exchange, these strategies have not progressed very far. Government agencies serving rural areas tend to be underfinanced and underequipped, their personnel are frequently underqualified, poorly motivated, all too often nepotistic and even corrupt. Administrative structures and procedures are often unsuitable for serving rural publics. Despite the devoted efforts of many African civil servants, the productivity of government spending on agriculture and rural development is unacceptably low and benefits have not been felt by the majority of low resource farming households. Compounding this problem, African governments spend most of their budgets on salaries; little is left to provide equipment, supplies or transportation for operating needs. They are now so strapped for revenues and so overextended financially that the expansion of any service that entails recurrent expenditures is virtually out of the question for the next several years. This fiscal crisis is compelling governments to search for alternative and supplementary methods of providing services to rural constituencies in the hope that these might somehow stimulate increased food production.

This paper deals with institutions. There is a large and controversial literature in the social sciences on the correct meaning and usage of the concept, "institution." (This literature is briefly reviewed by Uphoff, 1986 and Esman, 1972) We shall not venture into that thicket in this paper. In technical language, institutionalization is the process by which behavior patterns are incorporated into the routines of society, primarily through the sustaining power of organizations. For this exercise, however, we define an institution simply and straightforwardly as an organization, formal or informal, which provides useful services to low resource households in rural Africa. Individual institutions and especially networks of institutions enable a society to mobilize and sustain the capacity to define and address its problems, use resources productively, and adapt to changing needs. We shall analyze and evaluate institutions in a purely instrumental sense: which ones can contribute and in what ways to increasing economic productivity, enhancing security, and improving the quality of life for the rural publics on whom we focus in this paper. As a supplementary question we ask how African governments and foreign donors can facilitate and assist in the development of the institutions that are needed.

A. An institutional typology: pluralism and choices

In Africa as elsewhere program designers have some choice in the institutional channels through which services may be provided. Because institutions have distinctive capabilities and because each can draw energy and resources from different sectors of society, governments and donors should cultivate all of their potentialities and capitalize for individual programs on the most suitable institution or combination of institutions. The main institutional channels relevant to rural development are the following:

1) The bureaucratic agencies of the central government. These are functionally specialized units, established, financed, staffed, and managed under the authority of the central government. They are structured along hierarchical lines. Operating personnel in the field are governed by rules and procedures set at the center and are responsible and accountable to their superior officers in the hierarchy. Since independence, official bureaucracies have been the preferred channel for African governments. They are more or less amenable to central control and guidance, thus reducing the risk that regionally based ethnic communities or opposition groups may attempt to capture control of service agencies and their resources and thus be in a position to challenge the regime. Since modern technical and managerial skills remain in scarce supply, governments argue that these can be most efficiently deployed by the central authorities. The concentration of public employment at the center permits the authorities to fill these posts with persons who owe their loyalty to the regime. Not only are they better qualified, but, from the regime's perspective, they are also more inclined than those with parochial loyalties and local outlooks to carry out modernizing plans and programs.

Because of their political priorities and their development models, African governments have little confidence in autonomous or local institutions and they are frequently distrustful of private economic enterprise. Though sometimes willing to share in the profits of foreign owned private enterprise, at the ideological level they often regard private profit as antisocial and private business as the exploitative instrument of foreigners or of ethnic minorities. For these reasons and because they find local businessmen unwilling or unable to take entrepreneurial risks or to aggregate the capital needed for large investments, African governments have established and financed large numbers of parastatal enterprises or public corporations in all sectors of the economy. Many of them operate in fields directly associated with agriculture and some enjoy monopoly and monopsony positions in rural credit, in the supply of production inputs, and especially in processing and marketing.

Central governments attempt to provide services directly to rural publics through two kinds of hierarchically organized, functionally specialized entities: the line departments of government and public corporations (parastatals). Each department or corporation extends its services (extension, veterinary, irrigation, public works, marketing, electricity supply, health and family planning, etc.) vertically to rural areas, with little concern for other agencies serving the same publics. Thus the services provided by public bureaucracies tend to be fragmented vertically and poorly integrated on the ground. Public corporations are supposed to operate according to commercial criteria and methods, unlike government departments which are strictly circumscribed by rigid rules and procedures concerning staffing, financial accountability and purchasing. In fact, the procedural rigidities associated with normal departmental operations often spill over into the public corporations as well. Despite their monopoly position, many of the parastatals operate at a loss, requiring annual subsidies from impecunious governments.

The proliferation of central government agencies providing services to rural areas through their field offices provides an element of choice for program designers. Though they have many properties in common--and I shall reserve my treatment of their field operations to a later section--there may be significant differences among them. There is no such thing as the government bureaucracy. Each government agency constitutes a distinctive bureaucratic culture depending on such general factors as the professional backgrounds of its key staff, the technologies it employs, its orientation to the public, and on such specific factors as leadership, political clout, and relations with foreign donors. Not all government agencies are the same. The resulting organizational pluralism and the competition among them are frequently deplored by observers, e.g., that a dozen or more separate agencies serve agriculture. Actually this pluralism provides program designers with some freedom of choice for the placement of activities in the ministry, department, or public corporation which is likely to be the most hospitable and to provide the most satisfactory support.

2) Regional and local governments. In most of Africa the intermediate regional units of government have little or no autonomous authority. They are operating units of the central government, staffed by personnel on the central government payroll, responsible to central government departments, utterly bereft of autonomy and of revenue raising capacity. The same observation can be made for the districts, a holdover from the main unit of local administration during the colonial period. These units may

be, however, useful when we address the issues of administrative deconcentration in our subsequent section on bureaucratic reform.

A few African states, most prominently Nigeria, are organized on an explicitly federal basis. This means that the intermediate territorial units (the 19 states in Nigeria) enjoy a degree of formal constitutional autonomy. They elect their own governors and legislatures; in the distribution of powers a number of activities including many functions relating to agriculture and social welfare, are assigned to the states. Their performance has been disappointing because their revenue raising potential has been circumscribed, the managerial and technical quality of their personnel have been inadequate, and corrupt practices have abounded-- not unlike other federal systems, such as the United States and India in their early stages of development. Nevertheless, the federal structure offers opportunities for divesting from the overloaded central government a number of activities that must remain in the public sector and subjecting administration at that level to scrutiny and pressure from local publics. Developing these capabilities at the regional level is, however, a long term effort at institution building.

Local government is an imprecise concept. Territorially it usually refers to an area with an urbanized core and a rural periphery where economic exchange and social intercourse make common services desirable. Local governments have legally enforcible powers to perform services and to raise revenues. As distinguished from the local offices of central (or state) government agencies, they have some degree of autonomy and their officials may be responsible through elections to local publics.

Local governments have not flourished in Africa and some have atrophied since independence. (Mawhood, 1983) Central governments have shown little interest in genuinely autonomous local authorities; where they have sponsored local authorities they have arranged that central government or party officials are effectively in control and local representation is primarily symbolic. Any restructuring of service institutions should, however, take account of their potential for mobilizing resources, managing local facilities, and representing local constituencies.

3) Private business enterprise. The profit making sector is present in varying degrees in all African countries. The foreign owned private sector is represented by banks and insurance companies, trading corporations, industrial firms, and agro-business enterprises. The indigenous private sector generally operates on a much smaller scale; many firms are microenterprises in what has come to be known as the "informal" urban sector. Except for "outgrowers" associated with agro-business enterprises, low resource farming households encounter the private sector through indigenous distributors, traders, processors and money lenders.

The case for the profit making private sector focuses on freedom of enterprise as a human right, the diffusion of economic power, and the capacity of market discipline to enforce the efficient use of resources, promote innovation, and respond to public demands--so long as monopoly and collusive practices can be prevented. In many parts of Africa incentives for the private sector are limited and hampered by unsupportive government policies and by poorly developed public infrastructure. Governments often argue that indigenous entrepreneurs engaged in speculation, hoarding, and other sharp practices that exploit the public and confine their investments to low risk activities such as urban property development, avoiding more developmental activities in manufacturing, processing, and agricultural services. Moreover, governments are reluctant to see foreigners and especially ethnic minorities control important sectors of their economy. Therefore they believe they cannot refrain from entering these fields at least until truly native entrepreneurs emerge.

Nevertheless, the problems facing the agricultural sector in Africa, combined with the influence of foreign donors and international agencies are compelling African governments to reassess their attitudes and their policies toward the profit making private sector and provide them with greater opportunities. For many activities relevant to low resource agriculture, including the provision of credit, production inputs, drugs and contraceptives, the operation of processing facilities, marketing services, the private sector is an institutional resource that must be taken into account.

4) Voluntary agencies (PVOs). These are non-governmental, non-profit organizations operated under church related as well as secular auspices and oriented to providing charitable, educational, welfare, or developmental services. Many of these organizations are directed and financed by sympathetic bodies and individuals in industrialized countries. Some have developed indigenous leadership and sources of support in Africa and a few are entirely local. Prior to independence a substantial portion of the education and health services available to Africa was provided by and through voluntary agencies. Some PVOs now derive a substantial proportion of their funding from governments in Europe and North America, believing that "people to people" channels of cooperation are inherently valuable and that PVOs are more effective than African governments in working with disadvantaged publics, especially in rural areas.

Much of the activity of PVOs is devoted to disaster relief and the direct alleviation of hunger through large-scale feeding programs. During the past decade, however, many of the PVOs have been turning their attention to skills training and development assistance, mostly in rural areas focussing principally on health, agriculture, community development, and small scale manufacturing, crafts, and service enterprises. Their objective is to mobilize local energies and provide assistance through appropriate, affordable technologies so that communities will have the capacity to sustain improvements on their own. Since their activities are usually on a small scale and employ hands on methods of assistance that governments cannot duplicate, and because they avoid political activities, African governments usually tolerate and sometimes even welcome their participation. Their greatest strengths lie in the dedication of their personnel who are usually strongly motivated by a service ethic and by their ability and willingness to be flexible and responsive to local needs and to experiment on a small scale with technical and social innovations. Though sometimes charged with patronizing behavior toward local people, they are usually better able to work at the grassroots than official donor agencies or even representatives of host governments.

Active in African development at the grassroots, PVOs represent one of the alternative channels available to program designers. It is not certain how much they could expand the volume and scale of their operations without sacrificing some of their current strengths.

5) Local membership institutions (LMIs). These are self-help organizations that perform development functions. Their leaders are selected by and responsible to their members. They range from informal associations unknown to governments to more formal bodies chartered and assisted by the state. They are widely distributed in rural areas and vary greatly in the composition of their membership and the activities they undertake. The

three main types identified by Esman and Uphoff are a) local development associations performing multiple functions on an area basis, b) cooperatives of many types which pool the resources of their members for their mutual benefit, and c) interest associations whose members share common characteristics (e.g., women's groups) or needs (e.g., managing a local irrigation system).

Speaking analytically, the main development functions performed by LMIs are 1) to mobilize resources and manage local facilities, 2) to bring reliable local information and knowledge to bear on the activities of governments, 3) to provide and to integrate services to their members, and 4) to make effective claims on government. Until recently the potentialities of LMIs have been neglected by governments, donors, and academics alike, but enough has been learned about them to provide a prima facie case that they are indispensible participants in rural development in Africa. A separate section of this report is devoted to LMIs.

Few of the development services required by low resource farmers can be provided by any one of the institutional channels that have been outlined in the preceding paragraphs. This applies as much to government departments, the private sector, and voluntary agencies as it certainly does to local membership institutions. Extravagant and dogmatic claims are often made by the partisans of one set of institutions or the other--sometimes ideologically motivated--about their potential role in development, usually accompanied by disparaging attacks on their alleged competitors. This form of vain disputation is totally at odds with one of our main findings--that rural development in Africa requires contributions from all the institutional resources that can be mobilized for this purpose. Each has comparative advantages that need to be analyzed and better appreciated. The actual choice in every case must be pragmatic but specific judgements can be informed by the kind of analysis that we shall undertake in section B on institutional combinations.

For Africa it is important to arrive at a better balancing of institutional channels than what has prevailed in the quarter century since independence. The claims of central governments to a virtual monopoly of service provision has tended to overload the capacities of the state and its agencies and to preempt or exclude other avenues of service. The result is that resources are wasted or poorly used by overloaded central governments, while the few services that reach the majority of low resource farmers are often ill timed and poorly adapted to their needs. Yielding this monopoly will not weaken, but may actually strengthen African governments as they develop the kinds of institutional complementarities that normally characterize the provision of services in other societies.

Recent shocks have compelled African governments to move in this direction. First has been the creeping food crisis--the inability of agriculture to produce and market enough food to nourish expanding populations. The policies and the services provided by government departments and parastatals have been ineffective or at least insufficient to evoke the needed response, especially from low resource farmers. Compounding the food crisis is the fiscal stringency that confronts every African state, a condition that is unlikely to relax significantly over the next several years. African governments cannot undertake new or expanded programs that involve recurrent expenditures unless they cut back and save on activities that benefit particular constituencies. They have no choice but to foster, facilitate, and enhance the participation of other institutions and the mobilization of other resources. In so doing they may find helpful the ensuing discussion of institutional combinations.

B. Institutional Combinations

In their pioneering study of local institutional development Norman Uphoff and his associates concluded that institutional development strategies "need to be tailored in each situation to match existing conditions and needs . . . some mix of public, private, and voluntary institutions is relevant to practically every situation . . . efforts that focus narrowly on improving a single institutional channel are not as likely to be successful as those which support networks of institutions which reinforce each other." The field units of national bureaucracies are "commonly more effective in conjunction with (local) user groups and vice-versa; cooperatives are likely to get a better start with backing from a service organization (PVO); private business can do better when a local government provides infrastructure and services . . . ." (Uphoff, et. al., 1986) Therefore comparative advantage and linkages are critical to shaping institutional strategies for serving low resource rural households.

In an effort to determine which kinds of institutions enjoy comparative advantage for agricultural production and marketing, Uphoff found it analytically useful to identify and evaluate the processes to be performed, the natural and social environment, and the characteristics of the publics concerned, as well as the inherent capabilities of institutional types. Different combinations are likely to be useful for irrigated cultivation, for managing large herds under transhumant conditions, and for growing mixed crops under rain fed conditions; tree crops require different support structures than field crops. Activities which involve major capital investments and depend on sophisticated technologies may be better served by central government agencies; those that depend on local resource mobilization, local information and involve considerable local variation require the participation of locally based institutions. Commodities that demand continuous daily production, prompt processing, and rigorous quality control, for example tea, require highly disciplined membership institutions and active vertical linkages with processing and marketing institutions, unlike seasonal crops such as maize or oil seeds where group discipline and vertical interdependencies are less rigorous. State corporations generally perform poorly in agricultural production and not much better in processing and marketing where the private sector enjoys a comparative advantage. Among local institutions membership organizations seem better suited to agricultural tasks than are local governments.

Areas cultivated under harsh agronomic conditions with limited or unreliable rainfall such as those often associated with low resource farming in Africa are likely to be heavily dependent on local membership institutions. "Central governments find it difficult to staff and supervise their offices in less favored areas . . . local governments have a weaker economic and resource base to draw on . . . because the possibilities for profit are less than in richer, irrigated areas, private enterprises are less numerous and less developed." Private voluntary agencies and local membership institutions can better exploit the more limited opportunities in less hospitable environments. (Uphoff, 1986)

Both natural resource management and local public works are important to low resource farming in Africa. In social forestry as in range management, central government institutions have been ineffective partly because they have preempted and excluded local users. It has been found useful to involve local governments in the conservation and management of forest resources so that local information can be brought to bear on the establishment and enforcement of rules that are judged to be equitable by local residents. For range management with mobile users moving seasonally over large areas, territorially bounded local governments tend to be ineffective; central government agencies may be useful in providing veterinary, marketing, and similar services so long as they are administered conveniently and noncoercively, while the allocation of water and the management of grazing land should be left to user groups employing traditional sanctions to maintain the common resource on which all of them depend. Under certain circumstances private enterprise may participate effectively in the marketing activities of pastoral groups.

In their discussion of local infrastructure--roads, water supply, public facilities--Uphoff and his associates identified a sequence of activities from design to construction, operation, and maintenance. For each phase there are alternative and preferable institutional choices. Since these are public goods with limited opportunities for profit, the participation of private enterprise is likely to be limited to the construction phase. Central government agencies have much to contribute to technical design, but they are wise to consult with local governments or local membership institutions for local experience and the preferences of potential users. Operation is better entrusted to local governments or local membership institutions with technical assistance from central government agencies; the same applies to maintenance, which is a difficult problem in all developing countries. Cost-sharing, as well as participation in design contribute to the sense of ownership by local communities and their institutions. "One of the literature's most frequent conclusions is that . . . the willingness and ability of local institutions to discharge operational and maintenance responsibilities depends in large part on their having been involved in design and construction activities. So the idea of merely handing over responsibility to local institutions as a turn key project is not very promising." Local public works should not be "conceived and created independently of the institutions that will be responsible for the different stages, particularly the continuing ones of operation and management."

On questions of comparative advantage and effective combinations of institutions for services to rural publics, the number of variable factors is so great that at the present stage of knowledge no formulas are available for any activity. What we have are insights such as those cited above, gained from the preliminary review and evaluation of limited experience. On the basis of available evidence it is clear that program designers should avoid premature closure on institutional choices and carefully weigh the potential alternatives and combinations. They should think in terms of sets of complementary and interactive institutions. In general, the larger the investment involved, the more sophisticated the technology, the more uniform and predictable the local environment, the greater the relative capacity of central government agencies and their field staffs. When an activity is potentially profitable and if monopoly or monopsony can be avoided, private enterprise ought to be involved. Where there is considerable local variability and where local information, local resources, and local management capacity are important, local governments or local membership institutions enjoy a distinct comparative advantage. Private voluntary agencies are especially useful for activities that are experimental and require close working rapport with the more disadvantaged strata in rural areas.

Since several of these of these properties are likely to found in any specific activity, the contributions of more than one institution are usually required. This is why the linkage concept is so important when designing the institutional dimension of services to rural publics. Though the preferred institution may not be on the spot or may not previously have undertaken a specific activity, the promotion of appropriate institutions and the enhanced capabilities that they embody is an important component of a dynamic development strategy. The fact, for example, that private enterprise has not previously been involved in the processing of a local crop or that local government has not participated in the maintenance of feeder roads is no reason to exclude them permanently from such activitites where their participation can enhance the productivity or welfare of low resource farmers. All the case studies reviewed in Part V of this report illustrate the utility of institutional combinations and networks in the successful management of rural development activities in Africa.

C. Local Membership Institutions (LMIs)

LMIs have until recently been the most neglected of the institutional alternatives. It is in and through such institutions that rural people of modest status and means can participate in decision making and in carrying out activities that contribute to their social and economic well being. But while they embody and foster democratic values and processes, the involvement of LMIs can be justified entirely on such instrumental grounds as these:

1) They bring local knowledge to bear on programs and activities initiated and financed by governments. Government technicians, including those posted in field offices, are often remote from the specific natural and social circumstances, capabilities, needs, and preferences of rural

people in their particular micro environments. Sincere efforts to help rural people are often thwarted by ignorance or misperceptions of the local reality. Individuals of low status find it difficult to communicate with educated higher status officials. The literature is replete with instances of costly research findings that proved to be irrelevant and even detrimental to the circumstances of particular groups of small farmers; of dams constructed without seeking information from local residents that soon washed out in heavy rains. It is now commonly appreciated that illiterate, low resource farmers do have reliable knowledge based on their experience in extracting livelihoods under risky and unfavorable local circumstances, and that this experience ought to be taken into account in government sponsored activities. (Whyte & Boynton, 1983) It is primarily through their own institutions that ongoing information exchange with outsiders can be effectively carried out.

2) LMIs can mobilize local resources--labor, money, and management as well as information--to satisfy mutual needs that cannot be handled by individual action and as a supplement to resources provided by PVOs, government agencies, and even private enterprises. On their own or with limited outside help, LMIs can establish credit unions, exchange labor, construct feeder roads and bridges. As central governments are fiscally strapped, resources mobilized locally can make an important difference to rural people. For this, however, they need local institutions.

3) They can manage local resources and facilities and thus provide continuing services to their members. Small irrigation systems, transport and processing machinery, cattle dips, schools and clinics, local roads must be operated and maintained. Where local government is not available--and this is frequently the case in Africa--LMIs can and indeed have

successfully undertaken such activities. As governments are too thinly staffed in the field to provide services or resources to individual households, LMIs can retail to their members resources and services that governments can supply only on a wholesale basis. The mixture of governmentally and locally provided resources has come to be known as the "co-production" of services, the mutual dependency or partnership of government agencies and local membership institutions, neither of which can function effectively without help from the other.

4) They can make claims on government, politicians, bureacratic agencies and other outsiders that would otherwise be impossible. Governments in Africa suffer from urban bias; rural areas are neglected in the allocation of funds and services; low resource farmers and landless workers are the most neglected constituencies in rural areas. In the competitive contest for scarce resources, organization counts. Organization provides the means by which rural people can pressure governments, can demand more responsive treatment from field officers of government agencies and parastatals and induce them to integrate their separate activities on behalf of a common publics they are expected to serve. They can even strike better deals with private suppliers and traders. LMIs provide the means for the activation and the modest empowerment of low resource farmers which would be impossible for them acting as individuals.

On this particular theme one caution is in order. LMIs that emphasize making claims on governments--to the exclusion of self-help activities--are likely to become politicized and eventually coopted or destroyed by governments. In either case they lose their capacity to speak for local publics. PVOs and foreign donors cannot work with or through LMIs that are primarily political in their orientation.

There is a growing body of knowledge on LMIs, much of it summarized by Esman and Uphoff, (1984) though there is somewhat less data from Africa than from Asia and Latin America. Many LMIs are non-formal and small in scale, based on extended kinship and other face to face relationships that facilitate enforcement of mutual obligations for mutually valued services. In Africa many are headed by traditional chiefs. In the running debate over the relative advantages for development activities of informal-traditional and more formal "modern" organizations, it has become clear that existing organizations represent a form of valuable social capital that should not be casually displaced. Before attempting to initiate new, modern organizations outsiders should be certain that they know and understand what already exists locally. The presumption should favor working with, strengthening and adapting existing organizations rather than attempting to build new ones from scratch. Outsiders working with LMIs from government agencies or PVOs shold be prepared to serve as facilitators or "catalysts," entrusting management to the members, respecting their preferences, leaving them free to learn from their own mistakes. The more successful LMIs tend to begin with a single function and expand to perform related services. They may be overwhelmed if outsiders attempt, by providing financial incentives, to impose activities that exceed their managerial skills, produce unnecessary internal conflict, and provide opportunities for corrupt practices. The more successful LMI's do not remain isolated, but participate in networks of horizontal and vertical exchange, as will be discussed in the next section on linkages.

Very poor people whose numbers are increasing in rural Africa (e.g., the landless, female heads of households) are least likely to be active in LMIs. The more viable LMIs tend to draw on more established sources of leadership. Disadvantaged persons may nevertheless benefit when these institutions provide services from which they cannot be excluded or that are of relatively little interest to local elites. (Leonard, 1982) Organizations explicitly for the disadvantaged usually require sponsorship and protection from outside the community, e.g., PVOs, combined where possible with services from government that are directly addressed to their needs.

LMIs are vulnerable to inexperience, especially in record keeping and financial management, to corrupt practices by their leaders, to the hostility of local elites and locally based government officials, and to factionalism based on ethnic, kinship, or political differences. They are also vulnerable to attempts by politicians to exploit them for political advantage and by governments to control them by regulation, unrequited subsidies, and well meaning paternalism that preempts or undermines local initiative. For these reasons many LMIs fail to survive, but there are methods for neutralizing these threats. These include enforcing accountability of leaders to members, extending training in managerial and technical skills widely among the membership, respecting local customs and preferences in the structure and operations of LMIs and providing external assistance only as the counterpart to local self-help.

Prevailing approaches to rural development are nearly unanimous in assigning an important role to LMIs. The question is how they can best be activated and sustained. Summarizing the best available research on this subject leads to the following general common sense rules for outsiders inclined to promote or assist LMIs: 1) Respect the experience, the preferences, and the traditions of local people concerning the structure, procedures, and operations of their own institutions. 2) Where possible build on existing organizations; where new structures are needed, the catalyst method of assistance should be used and standard externally designed blueprints should be avoided; organizations should incorporate locally acceptable roles, procedures, group sanctions, and workways and should be allowed to evolve on their own. 3) So far as possible decisions should be taken openly and with maximum participation of members in order to ensure accountability and enhance participation. 4) Technical and managerial training should be diffused widely among members in order to achieve broad participation and enforce accountability. 5) Outsiders working with LMIs should provide assistance in measured amounts in order to prevent the emergence of debilitating dependency and avoid preempting and smothering local initiative. Outside assistance should therefore be conditioned on significant local contributions, enhancing incentives for self-reliance and self-direction. Beyond these general rules appropriate tactics are likely to depend on local specifics. (Esman & Uphoff, Ch. 6)

D. Linkages

The question of linkages arises because, as previously indicated, the goals of rural development cannot be accomplished by a single institution acting alone. Most institutions tend to be functionally specific and thus require complementary performance by others. For example, a veterinary department interested in improving the nutrition of livestock must depend on the department of agriculture which is responsible for and has expertise in fodder crops. An extension agency may depend on a local farmers association for access to the farmers it hopes to serve, while the marketing of their surpluses can be handled by private traders. Most organizations are based on the concept of division of labor, but the practical tasks involved in rural development create functional interdependencies and conflicts over jurisdiction, personal and factional jealousies, and bureaucratic procedures that may inhibit the necessary cooperation. The most common culprits are central government agencies with their rigid rules, command styles of relating with the public, and centralized decision making structures. Our next section on bureaucratic reform and reorientation will address this problem.

Though concrete patterns can be complex, analytically there are two kinds of linkages, horizontal and vertical.

Governments have long recognized the importance of horizontal linkages for promoting rural development. Even when they create super ministries for rural development, these never include all the central government agencies whose participation is needed. Governments usually attempt to coordinate ministries, departments, and parastatals interested in rural development by establishing coordinating committees or councils in the capital city or in provincial centers. These elaborate structures are usually ineffectual because they are too remote from the scene of action and often produce the kinds of gamesmanship in which each agency maneuvers to protect its own turf and enhance its own resources. Some governments have experimented with formal horizontal coordinating structures at the district level, close enough to the ground to make the effort appear realistic. Formal efforts at interdepartmental coordination at the district level usually falter; they can be effective only when 1) the various specialized agencies have deconcentrated enough decision making authority to their district offices to enable them to adjust and accommodate their activities to local needs 2) coordinating procedures are sufficiently informal and flexible that only the parties concerned are involved in particular meetings and exchanges; and 3) representatives of local groups are permitted to participate.

Formal coordinating mechanisms may sometimes be helpful in facilitating linkages at the local level by neutralizing the rigid and compartmentalized operations of the field staff of government agencies. Usually horizontal linkages evolve informally and pragmatically, reflecting functional interdependencies among institutions operating on the ground. One of the capabilities of organized publics (LMIs) is to compel the field staffs of specialized and hierarchically organized government departments to communicate and cooperate among themselves and with local government units and LMIs to accomplish practical tasks at the local level. Esman and Uphoff (1984) found that among LMIs their effectiveness correlates significantly with the vigor of the horizontal linkages they maintain at the local level.

Vertical linkages are also important to their success. Some enthusiasts argue that LMIs are most likely to succeed if the politicians and bureaucrats get off their backs and leave them alone, the premise being that politicians and bureaucrats tend to be corrupt, incompetent, exploitative, and self-serving. While these sentiments resonate with populist ideology they are contrary to research findings which demonstrate the importance of vertical linkages. Local membership institutions simply lack many of the resources needed to achieve their development goals and the more ambitious their goals, the greater the vertical interdependencies. Government agencies, PVOs, and private business always maintain vertical linkages with headquarters and suppliers outside the locality. The secret for LMIs is to maintain multiple vertical linkages, to capitalize on the prevailing institutional pluralism so that they do not become overdependent on a single channel for support and assistance.

The more successful LMIs may develop their own internal structures of vertical linkage. At the base are small units accustomed to informal patterns of cooperation and self-discipline. At the next level are larger, more formal structures, operating on a sufficient scale to manage common facilities and negotiate with private suppliers, marketers, and government agencies. At this intermediate level the roles of officers and their relations to the membership must be carefully defined; rules and procedures must be formally established and enforced for conducting their affairs because they are unable to rely on local face to face contacts for the necessary trust and social sanctions. Such federated structures combine for their members the benefits of solidarity and of scale. In some countries these structures reach up to provincial and central government levels, managing large scale operations and serving as pressure groups on behalf of favorable government policies and allocations (e.g., the Kenya Tea Development Authority and the Senegal Association for Health Promotion outlined in the case studies). The danger of carrying vertical linkages to this level is that LMIs may be co-opted or absorbed by government and thus lose their ultimate accountability to their members. This has been the fate of a number of federations of cooperatives. Vertical linkages, however, are a necessity for LMIs, enhancing their ability to tap needed resources and services and to transact on equitable terms with government agencies and private firms. Isolation is not an effective strategy for LMIs.

Michael Bratton has documented the value of linkage networks to the African farmers associations in Zimbabwe. (See the case study.) They maintain connections with a variety of government agencies, parastatals, and private firms, for example, the Ministry of Agriculture, the Windmill Fertilizer Company, the Agricultural Finance Company, the crop marketing union, the adult literacy organization, the savings department union, the Catholic church. As one group leader testified, "We can't just speak with one government worker to get all the things we need." In addition to mutual self help, they maintain active linkages with other organizations, vertical and horizontal. Bratton reports that organized maize farmers in Zimbabwe consistently outproduce unorganized farmers and that their margin of superiority increases as rainfall and soil conditions become less favorable--implying that LMIs can make their greatest contribution under more marginal and less favorable farming environments, exactly where low resource farmers are likely to be found.

E. Bureaucratic reform and reorientation

Since African governments will continue to participate in many of the services that are important to resource constrained farmers and since most of these services will be provided through bureaucratic vehicles, it is impossible to avoid the issue of bureaucratic reform. Some observers find this issue so intractable that they prefer to concentrate on methods of circumventing the state bureaucracies altogether. Their expressions of despair are based on the widespread corruption, nepotism, and incompetence in many African bureaucracies, their over centralized structures, rigid procedures, inward looking and self-serving behavior--in line agencies and parastatals alike. Yet these observers overlook the institutional pluralism that has already been mentioned, and they neglect the fact that some African bureaucracies work effectively under difficult conditions.

The question that needs to be addressed is how their performance can be improved.

Reform and reorientation are indeed necessary, but they cannot be achieved by grandiose, one shot, system wide campaigns but only patiently, pragmatically, and incrementally. Highly touted government wide reforms in personnel management, procurement arrangements, and expenditure controls have been attempted in many developing countries. Despite donor support they invariably collapse because senior politicians and administrators are insufficiently committed or equipped for the sustained effort and the conflicts needed to implement such far reaching institutional and behavioral changes. Fortunately, however, it is not necessary to wait for system wide reforms. Individual departments and programs can initiate and accommodate changes where expedient combinations of ministerial and agency leadership, donor initiative, staff dissatisfaction and local pressures make this possible. Their needs, in turn, can produce pressures for relaxing the system wide structural and procedural rigidities that encumber effective and responsive program management. The first rule is to work with individual agencies that appear to be interested in improving their services to low resource farmers.

1. Decentralization: Administrative Concentration and Devolution

Most African governments are overcentralized--too many routine decisions are reserved to ministerial and department headquarters and too little discretion is permitted to officials who are closer to the needs of the public. Action tends to be slow, based on rigid, uniform rules and unresponsive to local conditions. The principal remedy advocated by most observers and students of public administration is a substantial measure of decentralization. But decentralization has several dimensions. One of them is to allow regional and local government authorities responsible to their own publics to handle certain activities (e.g., constructing and maintaining secondary roads, operating schools and clinics, managing grazing lands and forest reserves) independently of the central government. This process by which the center divests itself of certain functions is frequently referred to as devolution. We have discussed it briefly in our section on local organization and will have more to say about it.

A second method of decentralization—one that is likely to be far more acceptable to most African governments—is administrative deconcentration. This is the process by which the headquarters of bureaucratic agencies require that significant decisions be taken by their field offices. While the power to act is retained by central government agencies, decision making is delegated to their field offices. This relieves headquarters of myriads of small decisions, speeds services to the public, and enables decisions to be more responsive to local preferences and needs. Deconcentration, however, is a matter of degree; it cannot be an all or nothing proposition. Important policy decisions, large projects, and major financial allocations must be reserved for headquarters, but numerous decisions can and should be taken closer to the ground. Deconcentration is actually a more sophisticated form of management than centralized operations. It is, however, a threat to the power that some headquarters officials exercise, since it requires them to shift their role from authority figures to technical specialists and resource persons facilitating field operations.

The implementation of deconcentrated program management requires a) clear statements of the scope and limits of field authority, b) effective vertical communications, c) higher levels of training and competence among field staff so that they can be trusted with increased responsibility, d) authority to expend money consistent with their control over substantive actions, e) headquarters influence through program guidance, technical assistance, post-audits, training, and inspections rather than by control over myriads of individual decisions. Deconcentration has to be implemented in stages as decentralized procedures are tested and field staff develop the confidence to take timely decisions in response to local needs. It is only under conditions of administrative deconcentration that field officers can have effective authority and incentives to coordinate local activities with those of cognate government agencies, private enterprise, PVOs, and local institutions.

There are perils in deconcentration, one of them being the reproduction of centralist patterns at the regional level which leaves local people little better served than they were before. There is a considerable descriptive literature on large scale efforts at deconcentration in Africa, but that literature is weak on evaluation and impact analysis. (Conyers, 1981, 1984) It appears, however, that efforts by African governments to deconcentrate all or large blocks of their services to regional authorities under the coordinating power of senior politicians or administrators have uniformly broken down. Reforms on this scale are resisted by headquarters staff, implementing procedures are seldom developed or applied, and politicians lack the stomach and the commitment to handle the conflicts and follow through with the detailed arrangements required to carry out such far reaching structural changes which might then confront them with apparent loss of control. (Rondinelli, 1981)

Though the data do not warrant dogmatic statements, it seems that prospects are more favorable for deconcentration when 1) it is undertaken for an individual program or group of closely related activities within a single administrative authority and 2) it is extended at least to the district level where timely and locally responsive action and ability to coordinate with related activities really make a difference to the public. Successful deconcentration even on this more modest scale constitutes a major administrative reform in procedures, authority relations and staff behavior that would require several years to implement. Several African governments (e.g., Malawi, Kenya) have recently undertaken to deconcentrate to the district level the operations of one or more agricultural services and even of the Ministry of Agriculture itself. I could not, however, find evaluative studies of these experiments. The establishment of one stop agricultural service centers where the field personnel of all the agricultural service agencies are housed facilitates administrative deconcentration, field coordination, and convenient access for the public. This is the scale at which deconcentration stands a reasonable chance to succeed and thus improve the delivery of services to rural publics.

2. Staff Behavior: Incentives and Rewards

Structural and procedural reforms are only half the problem. The other half relates to the behavior of field personnel who often lack the skills and the incentives to work compatibly with low income, low status rural people. Training to improve their technical and communications skills can be useful, but effective, training must be built into arrangements for career development and be reinforced by incentive systems which reward service orientation and success in working with rural people in and through their local institutions. (Korten & Uphoff, 1981) An example from the field of forestry: if field staff are evaluated and rewarded by the number of trees that are planted they will surely concentrate their efforts on the larger farmers; if they are judged by the number of households that participate in the program they will have a strong incentive to work with resource constrained farmers. Reward systems can greatly influence bureaucratic behavior.

As local membership institutions become more active in rural areas, their demands for more effective and more responsive service can evoke better performance from field staffs, but only to the extent that these field staffs are invested with sufficient operating authority to respond to local demands. Since substantial salary increases are not likely to be available in Africa even for poorly paid field personnel, some of the incentives for improved performance will have to be based on non-material rewards.

Donor agencies can make significant contributions to bureaucratic reorientation (using Leonard's metaphor, [1982] to improving "bureaucratic hygiene") by assisting with staff training, with structural and procedural improvements and with performance incentives. It is not enough for donors to attempt dramatic policy reforms in the hope that quick policy fixes will produce automatic and painless benefits. Donors must have the patience to work on improving the means of implementing policies, since it is through implementation that policy changes pay off. In agricultural and rural development, bureaucratic agencies will remain an important--though not the sole--vehicle for policy and program implementation. Instead of evading administrative reform--for example, by establishing special project units outside mainline government structures, or by attempting to circumvent government entirely--donors would be well advised to invest in improving the operational effectiveness of particular administrative institutions through which governments will continue to relate to rural publics. Their point of departure, however, should be the improvement of field operations in contrast to previous emhpasis on and investment in central office reforms.

A word on devolution. For most African governments devolution seems politically risky, since it implies some loss of central control and gratuitous opportunities for political opponents and ethnic minorities to gain local political bases. Some central elites also regard devolution as administratively inefficient and wasteful of resources. The main benefit to them is to relieve the center of functions it cannot perform effectively and cannot afford to finance. Where devolution is attempted, revenue sources must be conceded so that regional or local authorities can actually undertake the activities for which they have been formally vested with responsibility. As a practical incentive, central governments can provide matching grants to finance local development projects and share the costs of ongoing services. With assistance from foreign donors, central governments can help to strengthen the technical and administrative skills of regional and local authorities by training their personnel and by ongoing technical assistance. Though local governments and local membership institutions are primarily responsible to local publics, central governments can reinforce their probity and efficiency by audits and inspections, making them accountable both downward to their constituents and upward to the government. The best treatment of devolution in Africa is in Mawhood's 1983 edited volume.

In concluding this section, I would re-emphasize four points: 1) patient and incremental improvements in public administration represent a necessary long-term investment in the institutional capabilities of African governments to serve rural publics; 2) as the obstacles are political and cultural as well as economic and cognitive, bureaucratic operations and behavior cannot be "transformed," but only gradually modified and no one method will suffice; 3) administrative deconcentratino and changes in the incentive and reward systems for field personnel are two of the most promising avenues for bureaucratic reform; and 4) foreign donors can make useful contributions to administrative improvement by taking advantage of the pluralism in African governments, working patiently with selected agencies and programs where prospects for reform and reorientation seem promising.

F. Women in low resource agriculture

It is an established fact that in addition to managing and maintaining their households, African women play a major economic role in agricultural production, processing and marketing, in the production and sale of handicrafts, and even in off-farm employment. (Bay, 1982; Creevey, 1986) With the decreasing size of farm units an the large scale migration of males in search of cash income often across national borders, the responsibilities of rural women for farm management multiply their economic burdens.

It is also widely recognized that women tend to be underrepresented in and underserved by the institutions intended to assist low resource agriculture, the implicit assumption being that men are the responsible decision-makers. The upgrading of small-scale agriculture requires that this imbalance be corrected. In addition to helping rural women with health practices, nutrition, and handicrafts, public services must address their responsiblities as producers, processors and marketers of basic food products. This objective is inhibited by cultural norms and practices in many parts of Africa that limit the public role of women and by their generally low levels of formal education.

Governments can increase the employment of qualified women in government agencies, for example extension, that work directly with farmers and thus make needed public services more accessible to women. Where full-time or part-time paraprofessionals are employed to extend the outreach of service agencies in such fields as agriculture and nutrition as well as community health, governments can encourage the appointment of local women to these service positions. (Esman, 1980, 1983) Governments can require credit agencies to make loans to qualified women farmers. They as well as PVO's can facilitate and assist local membership institutions which are exclusively for women (mothers clubs) as well as those in which women participate prominently, (credit and marketing associations). Governments can also encourage the participation of women in elective and executive positions in local and regional authorities.

Institutional networks in rural Africa are impoverished by the limited participation of women and by their limited access to resources and services. The enhancement of their role is a function in some situations of capitalizing on existing opportunities and in others on long term social changes. Since this subject is covered in depth in the paper on human resources, I shall limit myself to these brief comments.

G. Uncertainty and variability

Statistical data on Africa tend to be unreliable. This reflects the prevailing dearth of accurate information, demographic, economic, agronomic, and institutional, especially in rural areas. The educated elites who plan and manage government programs from their urban offices and negotiate with foreign donors are often as handicapped as foreigners by the absence of accurate local information. This uncertainty is exacerbated by agronomic and social variability, by the distinctive properties of numerous microenvironments. The beginning of wisdom for those intending to intervene in rural Africa is to recognize and take account of the prevailing uncertainty. There are three methods for coping with the uncertainties that affect institutional as well as technical interventions:

1) Program designers must be prepared to invest in preliminary surveys to determine what institutions--formal and informal--exist, how they function, and what local publics consider to be reasonable relationships and divisions of labor between their indigenous institutions and those introduced by outsiders. Though gathering and analysing information is costly, venturing without information can be much more costly and there are rapid reconnaissance methods (Chambers, 1978) that can compensate for uncertainty and provide reasonably reliable points of departure. Appropriate consultation with experienced and knowledgeable individuals and with representatives of local communities, including but not limited to traditional influentials, can produce valuable information that may reduce subsequent margins of error.

2) Every such intervention should be treated as an action hypothesis that will work only if the original assumptions should prove to be valid. The expectation should be that unanticipated factors will surface and that some things will surely go wrong and have to be corrected. (Rondinelli, 1983; Korten, 1980) To catch these unplanned developments early, monitoring arrangements should be set up for every new program and governments should be prepared to adjust means and even goals to the new information that emerges from practical experience. In this way initial uncertainties can be gradually and substantially reduced. Architectural and blueprint models of institutional structures and behavior are especially vulnerable to unknown and unanticipated local preferences, expectations, and patterns

of behavior. If institutions are to accommodate to local societies, governments and donors must adopt a learning process approach; they must be sensitive to the need to permit adjustment and revision in the original designs even when outsiders believe they had already taken local experience and variations into account. For good reasons governments cannot be infinitely flexible in the institutional arrangements they can accept, but they must be prepared to exchange with local publics, to take their experience and preferences into account, and to adapt their own operation to local variations.

3) On institutional choices and design, governments are notoriously rigid but donors too are often less than helpful. Donors tend to promote institutional patterns and expect behavioral performance derived from experience in their own society without considering local experience or possible alternatives. Moreover, their requirements and procedures for approving projects often build rigidity into project operations that preclude the monitoring and adjustments necessitated by uncertainties in the physical and social environments into which their projects venture. Often they impose impossible burdens of paperwork and reporting on host governments as well as on their own field personnel. Donors need to insure that the resources they supply are responsibly and competently employed. Some of their detailed planning and meticulous reporting procedures are suitable for large construction projects where the principle factors are known and can be reasonably predicted and controlled; but where uncertainty and variability prevail, as in most rural development activities and especially where local institutions are involved, the need is for flexibility, for willingness to learn from experience, and for the ability to make expedient adjustments. Donors need to adjust their programming methods and

procedures accordingly. (Rondinelli, 1985) By adapting their procedures to the uncertainties in rural Africa, donors can help African governments to gather and to analyze data, including data derived from project operations, that will enable them gradually to learn more about the social and institutional dynamics in their local environments and thus provide the future basis for more effective program interventions.

Related to uncertainty and variability is the dynamic quality of the relationships between institutions and their environment. The suitability of particular institutions and even of networks may be superseded by technological changes, compelling incremental and even radical adjustments. An example from the field of public health: new pharmaceutical discoveries have revolutionized the battle against schitsosomiasis, which affects millions of African farmers. Previously the target was the vector, snails, requiring institutions that support engineering activities and environmental sanitation. The new technological opportunity (drugs) shifts the program focus to measures that inform, motivate and enable victims to use the appropriate drugs. Institutional choices and strategies must, of course, respond to the technological change.

H. Research and Education Relating to African farming systems

Most small farmers in Africa practice mixed farming, including subsistence crops, cash crops, and animals in complex patterns of seasonal rotation in an effort to extract maximum returns to their land and labor consistent with their need for food security. Farming systems have been adapted to variations in the natural environment and to social and cultural differences. While most agricultural research in Africa, as elsewhere, has been oriented to monoculture and to export crops, this has begun to change. Farming systems research focusing on food crops is now the prevailing doctrine in much of the agricultural research devoted to Africa including the international (CGIAR) centers. But while the general economic and agronomic implications of farming systems are now better appreciated, the institutional dimensions have not been sufficiently explored. Until institutional elements have been incorporated, the farming systems approach will remain a concept in search of a viable methodology. (For a significant methodological advance, not however oriented specifically to Africa, see Andrews & McDermott, 1985).

The prevailing doctrine of farming systems research holds that: 1) the problems to be investigated should be identified and defined initially by the farmers, women as well as men, not by scientists in their laboratories and experiment stations. 2) Farmers must participate in all aspects of the research enterprise. 3) Much of the research must involve interdisciplinary teams of scientists that specialize in crops, soils, and animals as well as economists and rural sociologists. (Byerlee et al., 1982; Gilbert et al., 1980) Interdisciplinary research does not come easily to scientists and it is not clear what kinds of incentives and rewards are needed to sustain interdisciplinary research on problems defined by grassroots farmers. While the literature on farming systems research has been silent about how farmers are to participate, it is not unreasonable to expect that meaningful participation must be within the framework of local farmer organizations (LMIs) and requires some matching contribution by the farmers themselves. Thus one of the first requirements of every farming systems research project is to identify local membership institutions that can cooperate with the research organizations; or help bring LMIs into being if none can be found.

Once research activities begin to yield results, the networks of institutions--governmental and nongovernmental--that provide ongoing services must come into play, e.g., veternary, credit, private traders, forestry, public works. A heavy burden will fall on the inadequately trained and poorly equipped extension staffs to maintain communications between farmers and research centers. This can be facilitated by the employment of agricultural paraprofessionals, a relatively low cost procedure, so long as the extension service provides continuing training and backup support to the modestly qualified paraprofessionals and is able to follow up promptly with specialist assistance. (Esman, 1983) Where services other than information are required, the farming systems approach encounters the same issues of local level coordination among the field staffs of specialized departments and of bureaucratic performance already discussed in section III E of this report.

To educate cadres of agricultural scientists Africa needs post-graduate faculties whose senior staff must be trained at the post-graduate level in donor countries. (USAID, 1985) The development of these educational centers is an institution building effort that must extend over a quarter century and require the sustained participation of donors, including hopefully cooperation among them. These faculties should be strategically sited in the major ecological zones. Models of agricultural education should be influenced by but not attempt to replicate the US land grant pattern. In addition to imparting the basic sciences, they should concentrate initially on basic food crops and teach scientists how to do research in an interdisciplinary, farming systems framework under African conditions, with the participation of rank and file farmers. From the outset these faculties should be oriented to African needs and African conditions.

The institutional challenges to agricultural research in tropical Africa are daunting even after agreement has been reached to focus in a farming systems mode on food crops and on the other needs of small farmers. While the international centers can concentrate on a selected number of high priority projects and can help to train African scientists, the bread and butter research operations, the ongoing contacts with farmers in their micro environments must be undertaken by research organizations in the various countries. With few exceptions, these national research centers are underequipped, underfinanced, critically short of qualified scientists, and isolated from the ongoing problems of low resource farmers. It will require a generation at least to build an adequate research infrastructure in most African countries, time, however, to learn more about how to manage farming systems research and relate it to the networks of service institutions, governmental and nongovernmental that serve agriculture. Meanwhile, this critical activity may require current expenditure support from foreign donors to supplement the limited financial capabilities of African governments. When donors help national research centers, they would be well advised to insure that they begin at an early stage to cultivate ongoing linkages at national as well as local levels with other agricultural service agencies and, of course, with farmer organizations.

Several African countries are too small and too poor to afford a full range of national agricultural research activities. For these countries methods must be found to share in the research findings of national centers in neighboring countries, to join in multinational research activities, and to participate in regional centers. This will require 1) multi-state agreements to finance and operate common institutions, a pattern that has not been notably successful in Africa or elsewhere, and 2) methods of linking regional research centers on an ongoing basis with national extension agencies. Donors may be able to assist in the launching of such multicountry or regional research centers and in protecting them while they evolve patterns of cooperation with national extension agencies that have a reasonable chance to be effective.

Institutional patterns for farming systems research and for operations to implement that research--national and transnational--remain to be worked out.

IV. How Can Donor Agencies Apply These Principles

1) Before dealing with the role of donors in institutional development, there is a prior burden that development assistance agencies face in some African countries: to convince governments that policy reforms and programmatic assistance to low resource farmers represent sound allocations of their own limited manpower and financial resources and that such assistance beyond the token level is feasible. Otherwise external assistance will be unavailing. In this section I shall assume that this barrier has been successfully crossed.

2) As donors, jointly with government staff, design specific assistance projects oriented to resource constrained farmers, they should examine the array of available or potentially available institutions for providing services. They should be wary of ideological predilections, avoid premature closure, and base their choice as far as possible on pragmatic considerations--what institutions and combinations of institutions are available and likely to work. Donors should avoid the tendency to overload government agencies and parastatals while recognizing that for some activities public bureaucracies may indeed provide the most effective channel. Donors may be able to persuade or assist governments to revise policies that inhibit the effectiveness of private voluntary organizations or of the private sector on matters that relate to low resource agriculture. One example would be to remove the monopolies and reduce the subsidies now enjoyed by some parastatals.

3) For every project addressed to small scale farmers, donors should begin with the assumption that it cannot succeed without the participation of the farmers they are intended to serve. Such participation must be channeled through organizations which the farmers can directly influence

and which are accountable to them. In the typology outlined in the text, this means local governments or one of the several kinds of local membership institutions.

In order that their participation be incorporated into project designs, donors may first have to persuade governments that autonomous local institutions in rural areas pose no significant threat to their regime and indeed may strengthen the regime by their positive contribution to social and economic development. Before deciding a priori on specific institutional types--for example, cooperatives or farmers associations--donors should help governments and encourage PVOs to look for data on local experience and local preferences. Where possible they should elect to work with existing institutions, building incrementally from that base, tolerating and even encouraging local variation. Only when existing institutions are unavailable or manifestly unsuitable should new institutions be attempted. In that event donors should see that they draw as much as possible on familiar patterns and use the catalyst method of providing assistance.

Though the instinct of governments, in the name of uniformity and control, is to impose standard institutional structures on local societies, this is usually a prescription for failure that donors should resist. Donors should a) help governments to facilitate the growth of local institutions but b) to tolerate local variations in their structure and operations, and c) avoid patterns of dependency that compromise existing processes of self-help and undermine incentives for local people to participate and to contribute. Governments and private voluntary organizations should be encouraged by donors to adapt the substance and the methods of their interventions to needs and preferences expressed by local organizations. Normally assistance should be provided only as the counterpart to matching local contributions, in order to enhance the responsibility of organized local publics for their own development. As a useful point of departure for specific tactics, donors might draw on recent findings in the literature on local rural organizations. (e.g., Esman & Uphoff, 1984)

4) Most programs are implemented at the local level through combinations of institutions. In program design donors should attempt to account for these networks, include appropriate assistance to all contributing institutions, and attempt to insure that impediments to their performance are eliminated. Donors should include incentives for project managers to seek out and to cultivate interinstitutional linkages, horizontal and vertical, since these are usually needed to draw complementary skills and resources into project operations.

5) Donors should be especially wary of the economists' fallacy that policy reforms can be self-implementing or can be implemented entirely through market mechanisms. Even when market processes are involved, the implementation of most policies and programs also require institutional channels and networks, many of them quite complex. There may be temptations to look for quick and easy policy fixes in order to avoid institutional issues, but where low resource farmers are involved institutional contributions and combinations are likely to be indispensible. They need to be considered in program design and cultivated in the course of program management.

6) Where government agencies are involved, donors should attempt to entrust programs to the agency or agencies most likely to support or protect them. This kind of judgment depends on a number of specific

considerations that cannot be reduced to formula, yet one might reasonably presume, for example, that an agency which is technocratic in its organization or whose established clientele consists of large commercial farmers might not be well suited to serve low resource producers. On the other hand, donors should avoid the proliferation of service agencies, especially of special project units; since these tend to become hot house entities, isolated from the normal operations of government, they soon collapse when the donor departs. Like every general rule, the inhibition on establishing a new agency may have to breached as a last resort when no existing structure seems appropriate, but only if the staffing and financial implications have been fully weighed.

7) Donors can and should use their influence vigorously to facilitate the deconcentration of decision making in the particular activities they support. This should be supplemented by structures and procedures that encourage coordination at regional and especially at local levels with related government programs and with the activities of PVOs, LMIs and the private sector. A good place to begin is with the establishment in the field of coordinating structures for the management of agricultural activities, equipped with the decision making authority, staffing control, technical skills and financial resources to make decentralized operations effective. Donors may have to lean rather heavily on some ministerial headquarters to make these structural changes work. At the same time they can support innovations such as the use of paraprofessional personnel that enable government agencies to extend their outreach at reasonable cost to larger numbers of resource constrained farmers.

8) To accompany these structural changes donors can sponsor reforms that assist field staffs to interact more productively and responsively

with small farmers. Here one enters the nitty gritty of bureaucratic operations that donors have usually avoided. Yet the payoff for much of their investment in new programs depends precisely on the performance of undertrained, unsupervised, poorly-equipped, and ill-motivated field personnel. (Esman, 1983) Donors can influence bureaucratic behavior at this level at rather low cost by assisting with training in technical and communications skills, by providing better transport and communications facilities to field offices, and by helping governments to revise incentive arrangements so that field personnel will be rewarded for good service to rural publics rather than primarily for seniority or for strict adherence to regulations. Where alternative channels are unavoidable and new agencies must be formed, donors cannot afford to allow the performance of field staffs to be neglected in the hope that the problem will somehow solve itself.

9) Institutional development requires an extended time frame and it cannot be rigidly planned. This is a lesson that donors have been learning and fortunately, it appears that they are under less pressure than previously to move money and to expect quick results from project expenditures. Donor procedures must, however, recognize that in rural development they will continue to encounter uncertainties and unpredictable contingencies that defy the meticulous planning, project review procedures, and reporting arrangements that consume so much of their staff time and impose unrealistic demands on cooperating governments. When such detailed blueprinting is taken seriously, it inhibits the essential learning and adjustment that are inevitable both on the substantive and institutional dimensions of projects, especially under conditions of great uncertainty.

Donors have tended to prefer large projects since the staff investment in project analysis and review is almost as great for a small project as for one many times larger. Rural development projects are necessarily rather small and the information available to support them is often fragmentary and unreliable. This problem can be met by block grants to private voluntary organizations or to government agencies for specific categories of rural projects, leaving the burden for analysis, review, approval and supervision of numerous small projects to these agencies, subject to general conditions established by the donors and to periodic audits and inspections.

To cope more effectively with uncertainty in rural development programs, donors must relax and in some instances discard the formalistic, analytical processes that now govern project choice and accept the reality that these are, in significant measure, experiments. (Rondinelli, 1983) Despite heroic efforts to reduce uncertainties, these are likely to be encountered as projects are implemented. Original designs must therefore be adjusted, not only once but perhaps several times as the parties involved learn from experience and until they find formulas that work. To lessen the uncertainty, donors should undertake rapid reconnaissance surveys to determine what institutional resources are available--including local institutions among the farmers themselves--and what inputs and supports might help them work more effectively. The monitoring machinery that is increasingly included in projects should focus directly on the behavior of institutions through which the project operates, so that adjustments and corrections can be made on the institutional elements of the project as well as on substantive outputs. And just as donors urge host governments to deconcentrate decision making, they should accord similar discretion to their own field staffs to revise the institutional components of projects when the original assumptions are overridden by experience. The learning process concept should be incorporated into donors' arrangements for project management. (Korten, 1980)

10) When should donors support special agencies to serve rural women and when should they attempt to strengthen or reorient the activities of existing institutions to the needs of women? There is a real danger that administrative units in departments and agencies, staffed by and devoted entirely to the interests of women, will become ineffective and isolated enclaves--a form of wasteful tokenism. Where women at the local level organize spontaneously, donors should support their efforts in the catalyst mode--a function that is well-suited to private voluntary organizations. Otherwise, donors should attempt to insure that a) government agencies move away from policies and practices that restrict the access of rural women to land, credit, and markets; b) orient agencies serving rural households to activities in which the participation of women is prominent; and c) encourage the employment of women as cadres in rural service institutions, especially those that are likely to interact with women in their economic roles.

11) The contribution of donors to agricultural research and education has been large and critical and is likely to remain so for a long time. In addition to the international centers now active in Africa, donors now recognize the importance of a) supporting national research institutions, especially those involved in food production and in farming systems research, and b) insuring that channels exist for relating national centers to farmers through extension mechanisms. In many African countries donors may have to seek alternatives to the United States land grant model for

building the knowledge factor into small scale agriculture. In addition to prevailing deficiencies in scientific and technical manpower and in knowledge about how to implement farming systems research, many African countries are too small to support a diversified research infrastructure. They will have to specialize in their own institutions, cooperate with neighboring countries, and share in the products of regional centers. Donors who quite properly urge African governments to share and participate jointly in research and graduate educational institutions might set an example by realistic (rather than mere rhetorical) cooperation in long term support of national and regional agricultural research and training institutions other than the CGIAR centers.

Donors have an important part to play in the development of national and regional research infrastructures and networks oriented to food production and to African farming systems. They can help with technical and management training for scientists and supporting staff, the equipment of research centers, and the sponsorship of regional institutions. Given the long gestation period for research institutions and the financial burdens confronting African governments, donors should consider underwriting a substantial proportion of the recurrent costs of the institutions which are necessary to form the infrastructure for agricultural research. Without sustained donor support it is doubtful that many of these institutions will ever get off the ground and without research support, prospects for increasing the productivity of low resource agriculture in Africa are grim indeed.

V. Summaries of Case Studies

These seven case studies, all from Africa, have been adapted from a set presented by Uphoff (1986) which, in turn, had been analysed by Esman and Uphoff (1984). For each case there is a brief description followed by the "lessons" they convey.

MALAWI: Community Self-Help Water Program

This impressive rural infrastructure program is one which has in ten years' time laid 900 miles of piping to serve 2,000 village taps and over 500,000 persons in rural areas at a cost of about $4 per person. The program was evolved in a "learning process" mode (Korten, 1980) under the auspices of the Department of Community Development and is now being further expanded with donor assistance.

Malawi has springs and streams in the hills which can feed gravity-flow water systems in the plains. The Department devised a method of approaching communities through their traditional chiefs and elders to propose cooperation. The message conveyed is essentially as follows:

> This is to be your project, not the government's. If you want to have better water, the government is prepared to work with you to get it. But the responsibility is yours, to manage as well as to build. (Liebenow, 1982)

The government offers to supply pipes, materials and training if the people will provide labor to dig trenches and lay the pipe. They should also select someone from their community to be trained as a para-technician, to supervise the work and to oversee maintenance of standpipes and water lines afterwards.

A Main Committee is formed for each service area (usually a locality), supported by Section Committees established in each village within the area, to organize the self-help labor, to arrange work schedules and allocate work among the villages. Branch line systems operate from each storage tank along the main line, with each branch line committee responsible for maintenance of its own branch. This complex structure works quite well in a centralized manner under the supervision of what is now the Ministry of Community Development. (Robertson, 1978; Glennie, 1979; Liebenow, 1982)

"The pivot of the Malawian program is the District Development Committee. This is an administrative and political body chaired by the district commissioner and includes the district's members of parliament, the chairpersons of the ruling Malwai Congress Party, League of Malawi Women and League of Malawi Youth, the district medical officer and other technical personnel." (Chauhan, 1983) All requests for a piped water scheme proceed through this committee.

PRINCIPAL LESSONS:

1. The combination of government agencies and several levels of local membership organizations.

2. Successful use of existing patterns of local membership organization.

3. The LMI is involved in all phases from design to construction, operation and maintenance.

4. Government operations are deconcentrated to the district level, where fixed operations of several government agencies are coordinated and major participatory organizations are represented.

5. The innovative use of low cost local para-professionals to provide essential technical services.

NIGERIA: Gombe Local Authority

The policy of indirect rule by the British colonial regime left considerable authority in the hands of traditional leaders in Northern Nigeria, who headed what were called the Native Authorities governing each sub-district area. (Native Authorities were renamed Local Authorities in 1968.) A case study of the Gombe Native Authority by Tiffen (1980:25) concludes that this region's comparative success in agricultural development has been due in large part to the performance of its local authority (LG).

All NAs had taxing authority for making local investments, but some mismanaged this authority, creating a disincentive to individual farmers to improve their production. The Gombe NA, however, carefully invested the taxes it collected in education, health, veterinary and agricultural services. The Gombe traditional leaders were generally progressive in encouraging agricultural modernization and setting a good example in their own fields. The traditional district and village heads, in turn, "propagandized innovations such as the use of fertilizer, worked their own farms actively, and keenly cooperation in the distribution of cotton seed, the organization of cotton markets, etc." (Tiffen, 1980:29)

After 1945, the government starting "democratizing" the system of local government by establishing offices for elected representatives. In Gombe, where the Native Authority heads were progressive, they were elected to the new Councils. The government, however, was reluctant to give much independent taxing and spending authority to local councils, thinking village people too illiterate to be allowed any control of funds. In Gombe this mattered less because there were many active interest groups which put pressure on higher authorities to invest in agricultural improvements which the local government could not undetake.

In communities with strong local leadership, despite the lack of formal taxing powers, "Village Heads who were good organizers could get rough roads constructed or classrooms built by voluntary labor, and they might be able to influence the central NA to allocate the necessary funds for staffing and maintenance." (Tiffen, 1980:32)

"The Village Head is the main channel for Government advice and orders to his people. The Agricultural Officer expects him to enforce the cotton close season (to curb diseases), to provide cotton seed dumps, to organize seed distribution and to disseminate information. The Veterinary Officer expects him to maintain cattle tracks and to inform cattle owners about innoculation facilities. The Forestry Officer expects him to protect Forest Reserves. He has to recruit labor for local public works. The Education Officer expects him to keep this village school full despite prejudice against western education. The District Officer expects him non only to collect taxes, but to maintain law and order, and all for a salary which in 1967 ranged from ƀ42 to ƀ345 per annum."

The government and donor-assisted development projects in the area that have not succeeded have been those that by-passed the Local Authorities, whereas those which had worked with and through the local government have had considerable success, Tiffen reports. One water scheme pushed through by high officials without local review and support was a waste of ƀ245,000.

LESSONS: "As Gombe has benefited with so little expenditure of centrally directed funds, we can take it as an example of the success of the policy of strengthening the rural institutional base of the Nigerian economy. The special political and administrative factors which favored its development are to be found locally, in the power structure that favors majority rural interests; in the effective leadership given by locally rooted families at District and Village levels; and in the comparative absence of extortion, which has meant that local farmers are not afraid to work for, and display, wealth." (Tiffen, 1980:35)

This case also illustrates:

1. The interdependence of government agencies and of local institutions on the maintenance of active linkages. Each needed the other.

2. The ability of local institutions to mobilize substantial resources for their collective benefit.

3. The effectiveness of local institutions in retailing to their members resources and services provided wholesale by government agencies.

Senegal: Women's Garden Groups

The establishment of women's garden groups built on traditional cooperation among Senegalese women in agricultural tasks, especially rice production. In the mid-1970s, the government initiated an agricultural development project during a period of drought when there were serious food shortages. Though a similar garden promotion scheme had failed a decade earlier for lack of demand, recent growth in tourism had created an increase in demand for tomatoes, potatoes, etc. and villagers; need for income had greatly increased. Hence the prospects of successful collective action were more favorable.

Since land could not be purchased outright, the groups began by securing use-rights from village authorities. Land was cleared and fenced by relying on the traditional division of labor; men cleared and prepared the land and also provided the labor for well digging. Because the wells frequently became saline, limited but essential technical assistance was given to the groups by UNICEF and by field offices of central government departments. Of particular value was the provision of cement and hand tools to line the wells. As no pressure was applied by outside agencies on the groups to take on a particular organizational design, each of the more than 50 groups has adapted its form to meet local needs and norms. A discussion of two groups indicates their diversity.

The women's garden group in Boucotte Ouoloff has 160 members, each of whom paid a membership fee of 1000 francs to join. Two presidents serve concurrently, the younger being in charge of "external affairs" (since she is bilingual) and the senior woman handling "internal affairs" (within the village). With assistance from village men, three hectares were cleared, fenced and a 12-meter well dug. Each member has individual rows to oversee on the plot. However, following the sale of their produce, members must individually contribute 2500 francs to a common fund. Monies have been used for such items as construction of a health/maternity center and construction of a road to the garden so it would be easier for the UNICEF-donated truck to transport commodities to city markets and hotels. Five hectares of trees have also been planted by the group to help alleviate fuelwood scarcity.

In the drier area of Dianky, another gardening group has 260 members, of whom 48 are men. Leadership remains exclusively with the women, however. This group works two hectares on a more collective basis than Boucotte Ouoloff. According to the group's president, the organization has "matured" rather quickly due to a previous experience with women's banking and a tradition of cooperative agricultural labor for growing rice and peanuts. Discipline within the group is strict. If a cultivator does not tend her rows, an empty basket is placed next to them. If the basket cannot be filled with produce from that person's row in the group plot, produce from her or his own individual plot must be contributed. With outside assistance, three improved wells have been built. The group has agreed to take on several experimental projects using new varieties of seeds, provided that they plan and decide what the projects will be. As with Boucotte Ouoloff, provision of a UNICEF truck has facilitated shipment of produce to Dakar, thereby increasing the quantity sold and the profits which each member received. (Yoon, 1983)

LESSONS: The dynamism in women's garden groups comes from their building on indigenous patterns of cooperation and because outside agencies were able to support the organizations without attempting to dictate their structure and procedures and without trying to determine how the tasks would be organized and what kinds of sanctions would be appropriate. External aid for water source improvements from government and from a foreign donor complemented the labor and skills already available. Provision of the truck allowed for new marketing linkages which brought groups together in ways that would not have occurred otherwise. An example of innovation in organizational structure when local groups are left to determine this themselves is the selection of a president for external affairs, (i.e., someone who is wise in the ways of Dakar and can speak French) and another for internal management.

ZIMBABWE: Farmers Associations

A systematic study was done by Bratton (1983) to determine the extent, functions and effectiveness of farmers associations in the rainfed communal (African-operated) areas of Zimbabwe. Interviews with a random sample of 494 households in four districts revealed that 44 percent of cultivators belonged to some form of voluntary agricultural association. The groups themselves covered a wide range of activities and had connections to a variety of public, private, parastatal and non-governmental agencies--the Ministry of Agriculture, the Windmill Fertilizer Company, the Agricultural Finance Company, the Cooperative Marketing Union, the Adult Literacy Organization of Zimbabwe, the Savings Development Movement, and the Catholic Church.

A classification of associations according to their sponsorship is understandable from the perspective of the capital city, but Bratton says, "for several reasons it is seriously misleading when viewed from the village. (a) Farmers and not field staff are the prime movers in creating and sustaining the farmers organizations. Farmers justifiably resist being defined as appendages of large, distant agencies. Example: a farmer in Wedza sternly corrected me when I asked if his was an "extension worker group" -- "does he (the extension worker) come here to join our group when there are fields to be planted or weeded?" (b) Farmers in groups feel free to enter transactions with several different agencies and are rarely bound by loyalty to only one. Example: a group leader in Mtilikwe explained that "we can't just speak with one government worker to get all the things we need." (c) Most important, farmer groups with nominally different 'labels' perform essentially similar functions." (Bratton, 1983:5)

In terms of the activities undertaken, 60 percent of the groups identified in the study engaged in *exchange of information* so as to diffuse technical "know-how" in agriculture. "In part, groups form to overcome the shortage of extension agents in the field and in part to consolidate and dispense existing indigenous knowledge." Just over half the groups engaged in mutual *work exchange* through work parties for planting, weeding and harvesting, sometimes sharing scarce capital resources like farm implements or draft oxen. Almost half of the organizations (47 percent) make *bulk* purchases of inputs, particularly fertilizer, and about one third (36 percent) did joint marketing to attain transport savings and better prices. About one-quarter of the groups were multi-purpose, usually with supply and marketing functions having been added to production (labor exchange) groups.

"The survey results confirm that, within each agro-ecological setting, maize farmers in groups consistently outproduce individual maize farmers. The effects of groups organization on maize output appear to become more marked as rainfall and soil conditions become less propitious. The implication, which needs further testing, is that farmer organizations make their biggest contribution to production in the more marginal areas." (Bratton, 1983:17)

LESSONS:

1. Farmers maintained strict control over their own organizations while capitalizing on multiple channels, governmental, private enterprise, and PVO to bring resources and services to their members.

2. Local membership institutions tend to be more useful when environmental conditions are less favorable.

KENYA: Kenya Tea Development Authority

KTDA has come to be recognized as a successful national institution, bringing smallholder tea production from zero before 1960 to one-third of Kenya's exports within 15 years. Many lessons can be learned from it as a case of institutional development at the national level (Lamb and Mueller, 1982). However, lower level institutions are critical to this national success.

The basic forums for farmer participation are the Divisional Tea Committees, made up of elected farmer representatives who oversee production and buying in their area. Farmer committees have been formed at locality level in many locations, but these are not uniform in their activity. The Divisional Committees elect representative to District Tea Committees, which are probably the best functioning of the organizations, partly because they make crucial decisions about allocating tea quotas and all producers have a stake in their operation.

The District Committees in turn send representatives to the Provincial Tea Boards. About one-third of the national KTDA Board is made up of farmer representatives. Farmers are also represented in increasing numbers on the boards that oversee the operation of tea factories through farmers' purchase of equity shares in what has become a means of mobilizing savings for capital formation in the agricultural sector.

From the outset, the KTDA leadership sought to provide for active farmer participation. Since smallholder tea growing was to be fitted into the existing farming systems, not to replace them, KTDA recognized the need to have institutions that could work with peasant households as very complex units. KTDA was willing to invest some of its financial resources to encourage participation, for example, by organizing farmer visits to Nairobi and by paying "sitting allowances" to farmer representatives for time they spent on KTDA business. It was recognized that close linkage between KTDA and growers was crucial for maintaining quality control. Accordingly, the structure of farmers' committees was made one of the four operational divisions of the Authority (the others were extension, buying and quality control, and factory production).

Most of the initiative for this structure came from "above." Indeed, Steeves (1975:10) has characterized the organization initially as "autocratic." But over time, grower initiative has increased, with KTDA approval. The technical sophistication of farmers has also increased. One "breakthrough" for expanding tea growing with quality control was to introduce vegetative propagation in place of earlier nursery techniques. Farmers learned this technique rather quickly and before long were able to do it better than many KTDA staff. In 1980, about half the demand for new tea bushes was met from growers' own stock.

Interestingly, the KTDA staff have continued to champion the acreage ceiling on egalitarian grounds despite political pressure from somewhat larger growers (Steeves, 1984). One consideration is that smaller holdings are generally more intensively cared for and more carefully plucked, keeping quality of the final product high.

The incentive system worked out is ingenious. Once a month, growers are paid a fixed rate (per kilogram) for the greenleaf delivered to buying points operated by the factory they sell to. At the end of each season, when the processed tea has been sold at the London auction, where most KTDA tea fetches a premium price, the growers get a "bonus," which usually amounts to about 150 percent of the "base" income. The better the quality of the tea leaf delivered to the factory, as well as the better processing there, the more the factory's tea sells for, and the higher is the bonus growers receive.

LESSONS: KTDA is a parastatal agency. One important element of KTDA institutional strategy has been its operating deconcentration to the factories and to the provincial, district, and divisional levels. This is combined with active participation at every tier of farmers organized in modern-formal rather than traditional informal units, the latter being unavailable. The fact that the tea price is rather precisely pegged to independent measures of "quality" gives all within the system--growers, buyers, transporters, factory workers and managers--good measures of success and makes decentralized management more feasible. Everyone gets clear feedback on the quality of their collective performance which is reinforced by material incentives.

For many years, it was said that tea was too demanding a crop for "peasants" to grow. Thus all investment and technical assistance were reserved for the tea plantations in Kenya. The performance of KTDA has shown that a system of organization with small farmer participation from the field to the factory, and beyond that to the national level, can achieve superior quality and efficiency.

NIGERIA: Tiv Farmers' Association

In the early 1950s, Tiv tribal leadership in the southern part of what is now Beneu-Plateau State designed a rotating credit system based on a traditional method of saving yams, to make larger amounts of credit available to farm families. The group worked through elected leaders, had a strict policy of loan repayment, and were "reorganized" on an annual basis. The last element was designed to avoid the impression that a permanent membership commitment was required.

After more than a decade of impressive performance by these organizations (called bams), a government agricultural extension officer who was well acquainted with the region suggested to the senior tribal leadership that a farmers' association be developed to work closely with the extension service. Initially a "senior council" was organized with 60 representatives from various Tiv areas. Following the growth of the association to some 1,000 members by 1968, it was decided to organize at the village level, drawing on the experience gained by the bams. Benefitting from strong traditional social structure and low stratification among the Tiv, village branches were established. Both agricultural extension officers and Farmers' Association leaders assisted in this effort to organize "permanent" member associations.

Although considerable informal communication facilitated by process of organizing credit branches, the initiative for forming organizations usually came from the extension officer who would meet with the village chief and farmers to discuss the details of the Farmers' Association, including the system of representation at district and division levels. Once operating, village associations met on a monthly basis with visits, usually three or four times per year. Within six years, the Tiv Farmers' Association has more than 33,000 members and a yearly operating budget from dues of $65,000. The average on-farm income over a decade showed a 72 percent increase. (Morss et al., 1976:F32-F41)

LESSONS: This case offers an impressive example of using traditional structures of authority and locally tested principles of organization, albeit with some modification, to initiate a new form of organization. By being sensitive to what already existed and without any donor funding, a government field officer was able to make his own work (extension efforts aimed at encouraging agricultural innovation) more effective. Even though government provided much of the impetus for getting activities started, farmer control over decision-making was maintained. Despite the fact that adult functional literacy was only around ten percent, the program does not appear to have been adversely affected by lack of "educated" leadership.

SENEGAL: Pikine Primary Health Services

This project was begun in an area near Dakar in 1975 to provide health care to dispersed rural hamlets. The plan was to have many small health units rather than a few large health centers. The project was started in a two-room private house, with staff provided by the Ministry of Health.

The community's contribution, apart from paying fees for treatment, was to co-manage the health services by electing a health committee to control the internal financial procedures and to provide a link between the primary care practitioners and member families. At regular intervals, new health committees were formed and new health units opened.

All the local health committees were unified into an Association for Health Promotion, officially recognized by the government in May, 1980. The role of the government in backing up its staff is to monitor the effectiveness of coverage, plan programs and logistics, stimulate community capacity to solve problems, provide efficient technical guidance, support the accounting system, and take care of seriously-ill referred patients. (Jancoles et al., 1981)

LESSONS:

1. A well-conceived government effort can elicit an effective community response leading to the coproduction of a valued service that government could not provide and manage on its own.

2. Few PHC programs have had such a federation of health committees providing vertical linkage to strengthen the program. It may put some uncomfortable pressure on government agencies to perform their tasks better, but it also creates a constituency for health care that can support the Ministry when political clout is needed.

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Appendix I

I. Networks (Institutional Combinations) Affecting Low Resource Agriculture in Africa

The concept of institutional networks is rather new among students of development and of development administration. It is not what researchers had been looking for. Polemicists have preferred to extoll the virtues of free enterprise, of government operations, of private voluntary organizations, or of local self help rather than the productive linkages between them. The theoretical case for networks based upon comparative advantage, division of labor, and the mobilization of all available and scarce institutional resources is compelling, but its application to specific activities that serve African agriculture, especially low resource agriculture, remains scantily represented in the literature. Thus, I do not have a solid empirical base, especially of success stories, for specific generalization about networks.

Some things, however, we do know. We know that governments are everywhere unsuccessful in managing agricultural production which is best left to individual farm households. Governments tend to be inept and heavy-handed in agricultural marketing which should be handled by private enterprise or cooperatives. Research for small farmer crops and livestock, especially food crops, is usually a government activity as is extension. But government extension services can be supplemented in the diffusion of useful information by the suppliers of production inputs, private traders, and cooperatives. Governments can facilitate the supply of production credit to small farmers but this can be supplemented and administered through banks or by local membership institutions through group credit arrangements. Local government is better suited to the provision of public goods--roads, schools, water supply--than to agricultural inputs to individual households. In the retailing of credit, information, and other production inputs and in the management of processing facilities and of small irrigation systems, local membership institutions can play a major role. The nature of the commodity and the degrees of interdependence among farmers affect specific patterns of useful collective action and of institutional linkages. (The more the interdependence, the greater the need for collective action throught LMIs). These are some of the building blocks for further exploration and refinement of the network concept, about as far as one can safely generalize at the present state of knowledge. While the empirical base is limited, the following examples of African success stories suggest how productive this approach may be. These success stories are drawn from Norman Uphoff's pioneering survey and analysis of the literature, supplemented by my interpretation of the data. (Norman Uphoff, Local Institutional Development: An Analytical Handbook with Empirical Examples, Westview Press, 1986 [forthcoming].)

1. Credit--the Cameroon Credit Union League

The rotating credit associations known as *njangi* in Cameroon have a long tradition in this part of Africa which may have its genesis in cooperative land-clearing groups. The monetized *njangi* have been documented from the 1930s, though their savings and loan function probably goes back to an earlier date.

In 1963, two Roman Catholic priests undertook to establish more formal credit unions. With assistance from the Department of Cooperatives, independent primary credit unions formed the Cameroon Credit Union League which was given official recognition by the government. Financial assistance received from a variety of agencies facilitated training, equipment purchases and supervision. A strong desire among people to participate in savings and loan activities, coupled with a common knowledge of the procedures and operations allowed the League to expand rather quickly.

The *njangi* and the primary credit unions follow almost identical operating procedures. The credit unions, however, are more advantageous for those who need or want to borrow money since the interest rate they charge is substantially lower. Since the Credit Union League has external auditors, savings and loans do not have to be returned annually, a practice that the traditional groups must normally follow to retain their legitimacy.

Credit unions have not attempted to eliminate traditional group savings and loan mechanisms. In fact, they often thrive side by side with linkages beginning to appear. "In one location a groups has become a 'member' of a credit union, and regularly deposits its savings there in a single account. Elsewhere all the members of a group have joined a credit union." (DeLancey 1977)

An interesting and important part of the expansion involved using existing organizations including church organizations, police detachments, agricultural cooperatives and large firms. By drawing on all the capacities of these organizations, and devising a check-off system whereby savings could be automatically deducted from wages, the credit unions were able to increase their efficiency. Between 1965 and 1979, membership rose from 4,000 to 26,000 with savings rising from 16 to 400 million CFA francs over the same period. The success of the expansion effort is reported to be in large part a result of relevant services of government and the Credit Union League's "ability to foresee problems and experiment with solutions." (DeLancey 1977)

This experience produced complex linkages between a private voluntary organization, well established local membership institutions, and a government department in expanding the availability of credit and insuring its repayment.

2. Extension: The Tiv Bams in Nigeria

In the early 1950s, Tiv tribal leadership in the southern part of what is now Benue-Plateau State designed a rotating credit and savings system based on a traditional method of saving yams, to make larger amounts of credit available to farm families. The group worked through elected leaders, had a strict policy of loan repayment, and were "reorganized" on an annual basis. The last element was designed to avoid the impression that a permanent membership commitment was required.

After over a decade of impressive performance by these organizations (called bams), a local agricultural extension officer who was well acquainted with the region suggested to the senior tribal leadership that a farmers' association be developed to work closely with the extension service. Initially a "senior council" was organized with 60 representatives from various Tiv areas. Following the growth of the association to some 1,000 members by 1968, its was decided to organize at the village level, drawing on the experience gained by the bams. Benefitting from strong traditional social structure and low stratification among the Tiv, village branches were established. Both agricultural extension officers and Farmers' Association leaders assisted in this effort to organize "permanent" membership associations.

Although considerable informal communication facilitated the process of organizing credit branches, the initiative for forming organizations usually came from the extension officer who would meet with the village chief and farmers to discuss the details of the Farmers' Association, including the system of representation at district and division levels. Once operating, village associations met on a monthly basis with the extension worker in the area. In addition, the extension officer made subsequent visits, usually three or four times per year. Within six years, the Tiv Farmers' Association had more than 33,000 members and a yearly operating budget from dues of $65,000. The average on-farm income over a decade showed a 72 percent increase.

This case illustrates the effectiveness of a network that involved the government extension service and local membership organizations--in this case, assisted and legitimateized a by highly institutionalized "traditional" structure of authority.

3. Production and Marketing of Food Crops: The Zimbabwe Farmers Association

A systematic study was done by Bratton (1983) to determine the extent, functions and effectiveness of farmers associations in the rainfed communal (African-operated) areas of Zimbabwe. Interviews with a random sample of 494 households in four districts revealed that 44 percent of the cultivators belonged to some form of voluntary agricultural association. The groups themselves covered a wide range of activities and had connections to a variety of public, private, parastatal and non-governmental agencies--the Ministry of Agriculture, the Windmill Fertilizer Company, the Agricultural Finance Company, the Cooperative Marketing Union, the Adult Literacy Organization of Zimbabwe, the Savings Development Movement, and the Catholic Church.

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In terms of the activities undertaken, 60 percent of the groups identified in the study engaged in *exchange of information* so as to diffuse technical "know-how" in agriculture. "In part, groups form to overcome the shortage of extension agents in the field and in part to consolidate and dispense existing indigenous knowledge." Just over half the groups engaged in mutual *work exchange* through work parties for planting, weeding and harvesting, sometimes sharing scarce capital resources like farm implements or draft oxen. Almost half of the organizations (47 percent) made *bulk purchases of inputs*, particularly fertilizer, and about one third (36 percent) did *joint marketing* to attain transport savings and better prices. About one-quarter of the groups were *multi-purpose*, usually with supply and marketing functions having been added to production (labor exchange) groups.

"The survey results confirm that, within each agro-ecological setting, maize farmers in groups *consistently outproduce* individual maize farmers. The effects of group organization on maize output appear to become *more marked* as rainfall and soil conditions become *less propitious*. Whereas group members produce nearly twice as much as individuals in Chipuiriro, they produce almost three times as much in Gutu. The implication, which needs further testing, is that farmer organizations make their biggest contribution to production in the more marginal areas." (Bratton, 1983:17)

This network involved active farmers associations, (LMIs) transacting through multiple channels with several government agencies, cooperatives, private voluntary organizations, and private enterprises. It is doubtful that any of these organizations could have met their program goals without the active participation of the local membership institutions.

4. Production, Processing and Marketing of Export Crops--The Kenya Tea Development Authority

KTDA has come to be recognized as a rather successful national institution bringing smallholder tea production from zero before 1960 to one-third of Kenya's exports within 15 years. Many lessons can be learned from it as a case of institutional development at the national level. However, lower level institutions are critical to this national success.

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The District Committees in turn send representatives to the Provincial Tea Boards. About one-third of the national KTDA Board is made up of farmer representatives. Farmers are also represented in increasing numbers on the boards that oversee the operation of the tea factories through farmers' purchase of equity shares in what has become a means of mobilizing savings for capital formation in the agricultural sector.

From the outset, the KTDA leadership sought to provide for active farmer participation. Since smallholder tea growing was to be fitted into the existing farming systems, not to replace them, KTDA recognized the need to have institutions that could work with peasant households as very complex units. KTDA was willing to invest some of its financial resources to encourage participation, for example, by organizing farmer visits to Nairobi and by paying "sitting allowances" to farmer representatives for time they spent on KTDA business. It was recognized that close linkage between KTDA and growers was crucial for maintaining quality control. Accordingly, the structure of farmers' committees was made one of the four operational divisions of the Authority (the others were extension, buying and quality control, and factory production).

Most of the initiative for this structure came from "above." Indeed, Steeves has characterized the organization initially as "autocratic." But over time, grower initiative has increased, with KTDA approval. The technical sophistication of farmers has also increased. One "breakthrough" for expanding tea growing with quality control was to introduce vegetative propagation in place of earlier nursery techniques. Farmers learned this technique rather quickly and before long were able to do it better than many KTDA staff. In 1980, about half the demand for new tea bushes was met from growers' own stock. (This has placed some strains on the policy of limiting individual holdings to one acre maximum).

This is the case of a parastatal institution operating through a decentralized management pattern linking with local membership institutions which were originally sponsored by the government agency, but have since evolved into a very active and self-sustaining network of their own.

5. Social Forestry--The Senegal Africare Reforestation Project

The Senegal Forest Service works with Rural Community Councils on this project, providing implements, tractors, seedlings, transportation, etc., while the community through its local government Council contributes labor to plant the trees. The division of responsibility is such that the Forest Service continues to oversee the plantation once established, but the Councils can decide independently what to do with the wood. Income generated from the sale of wood goes into the Councils' funds for rural development, to be used according to their own priorities.

Maintenance of the planted area is the responsibility of the Councils. Nonetheless the Councils were not "abandoned" since at one point, when the villagers could not keep up with the weeds, the Forest Service moved in with tractors and disks to help out. Due to efficient cooperation and co-management between the Forest Service and the Councils, almost double the targeted area was planted without additional funds. However, a local nursery could not be planted due to a shortage of water and Forest Service agents.

Such locally-managed reforestation programs are less costly, higher yielding, and more successful than the large-scale, government-sponsored industrial plantations in Senegal, according to the evaluation by Weber (1981). This collaboration is possible if technical assistance, material, equipment and funds are provided by the administration, and if the local government, in return for contributing labor, enjoys the economic benefits of the project.

Local governments seem to play only a marginal role in agricultural activities. This social forestry project however, demonstrates the utility of linkages between a government agency and local government institutions. It suggests a pattern that may be increasingly useful in Africa as the restoration and efficient utilization of its forest cover becomes a matter of urgency in resource management.

6. Water Supply--The Malawi Community Self-Help Water Program

This impressive rural infrastructure program is one which has in ten years' time laid 900 miles of piping to serve 2,000 village taps and over 500,000 persons in rural areas at a cost of about $4 per person. The program was evolved in a "learning process" mode under the auspices of the Department of Community Development and is now being further expanded with donor assistance.

Malawi has springs and streams in the hills which can feed gravity-flow water systems in the plains. The Department devised a method of approaching communities through their traditional chiefs and elders to propose cooperation. The message conveyed is essentially as follows:

> "This is to be your project, not the government's. If you want to have better water, the government is prepared to work with you to get it. But the responsibility is yours, to manage as well as to build." (Liebenow, 1982)

The government offers to supply pipes, materials and training if the people will provide labor to dig trenches and lay the pipe. They should also select someone from their community to be trained as a para-technician, to supervise the work and to oversee maintenance of standpipes and water lines afterwards.

A Main Committee is formed for each service area (usually a locality), supported by Section Committees established in each village within the area, to organize the self-help labor, to arrange work schedules and allocate work among the villages. Branch line systems operate from each storage tank along the main line, with each branch line committee responsible for maintenance of its own branch. This complex structure works quite well in a decentralized manner under the supervision of what is now the Ministry of Community Development.

"The main pivot of the Malawian program is the District Development Committee. This is an administrative and political body chaired by the district commissioner and includes the district's members of parliament, the chairpersons of the ruling Malawi Congress Party, League of Malawi Women and League of Malawi Youth, the district medical officer and other technical personnel." (Chauhan, 1983) All requests for a piped water scheme proceed through this committee.

Water management for agricultural production is an activity in which interdependence among farmers creates the need for active local membership institutions which must link up with government agencies that operate large irrigation and drainage systems. I could find no such case in sub-Saharan Africa, but the Malawi rural water supply case is an instance of productive linkage between a government agency and a local community to supply household water. This linkage survived the construction phase and produced a sustained capacity to operate and maintain a valuable public service that would otherwise have been unobtainable.

II. Guidelines for Making Choices Between Institutions in the Current African Context

1. Choose institutions that make minimum demands on the overloaded financial and managerial capabilities of central governments. Where possible look for alternatives to central government operations such as non-profit voluntary agencies, profit-making private enterprise, or local authorities. The most important concept emerging from recent research is the importance of service networks in which the burden of providing services is shared by one or more government agencies, the private sector, and local memberships institutions, activity by activity, through division of labor that taps all available institutional resources. In institutional choice, avoid premature closure on a single central government institution in favor of a broader and more careful assessment of the institutional combinations (networks) that can be tapped and developed for any proposed activity. In deciding to draw on and foster local authorities or local membership institutions, be aware of the concerns of African governments about the risks of conferring power on local groups whose loyalty to the regime may be in question. Yet one of the most important tasks of political development in African countries is to come to terms with the social pluralism

that will prevail long into the future. Increasing social participation will reduce the prevailing gap between state institutions and society.

2. Where government institutions are involved, avoid the proliferation of parastatal enterprises (public corporations). Though they are supposed to keep "politics" out of public business and to avoid the restrictive financial, procurement and personnel procedures required by line government agencies, in fact they have proved to be even more vulnerable to nepotism, corruption and incompetence. Accountable to no one, they are still compelled on crucial economic decisions to yield to expedient political demand. A compelling priority in institutional development for African governments is to build the operating competence, responsiveness, and processes of accountability of the mainline government departments and agencies--a strategy that is undermined by frequent recourse to parastatals.

3. At the local level, identify and work with and through existing institutions, including local membership institutions where this is possible. Though some observers (and many officials of central governments) may reject or dismiss local institutions as "traditional" and elite dominated, they represent valuable social capital and command support and legitimacy that newly sanctioned state-sponsored organizations can seldom match. The imperative of local participation is now accepted by serious students of agricultural and rural development. The more legitimate the local membership institutions through which participation occurs, the more governments must deal with them on an exchange rather than a command basis which may irritate some national level politicians and members of the civil service. But the ability of government alone or through state established local organizations to evoke local cooperation is usually illusory. Thus, those institutions which can claim legitimacy in local

societies are likely to be far more effective partners of government in service networks.

Where, however, there are no local institutions and where despite presumptions to the contrary they prove to be unsuitable, local organizations promoted and sponsored by government must be accorded the leeway to operate according to procedures and roles with which local people feel comfortable. When details of structure and procedure are dictated and blueprinted by governments--and there is a strong drive for uniformity and control in most government bureaucracies--the resulting organizations will be perceived as extensions of the state to be exploited for what practical benefits they confer. They will evoke, however, minimal commitments of energy and resources by local people who will not regard such institutions as belonging to them and serving their collective interests.

III. Overcoming Inhibitions to the Participation of Low Resource Farmers in Local Membership Institutions

For most persons, including low resource farmers, participation in any organization involves costs in time, energy, and sometimes money and labor while the benefits, material and social, may be uncertain and at best delayed. In some cases, where government officials or local elites disapprove, the costs of participating in LMIs may be quite high for poor farmers. In general, the rural poor will participate only 1) if they are convinced that the material and social benefits will exceed the costs in a reasonable time and, 2) if they regard the organization and its rules and requirements as legitimate.

The perception of net benefits is partly subjective, but obviously an organization that demands more of its members than it gives within a reasonable time will not maintain their willing participation. Fortman and Roe report the refusal of members of small dam groups in Botswana to follow procedures prescribed by government because the members considered these procedures onorous and unnecessary, and as impositions on them unilaterally by government as the price of qualifying for government assistance. Nevertheless, they continue to participate (to invest their time and labor) in those activities of the organization which they consider economically necessary and beneficial. Not surprisingly, people will not continue to invest their time in activities that they consider useless or only marginally productive.

Only so long as the material rewards are substantial, will farmers participate in an organization that fails to operate in ways that they consider proper and legitimate. One dimension of legitimacy is that members be consulted about the activities to be undertaken, the methods by which they will be managed, and the obligations that their participation entails. Within broad limits, this means that activities cannot be prescribed by sponsoring government agencies or PVOs but must be jointly determined both in substance and in methods. Another dimension of legitimacy is that the institution operate according to procedures that the members consider proper and consistent with local norms and expectations. The positive lesson for external sponsoring agencies is that they should identify and work with existing local membership institutions in order to take advantage of their legitimacy and their local experience; at the same time they should avoid standard organizational blueprints or other measures that stamp these institutional innovations as external and dominated by outsiders. Respect for indigenous experiences is one of the integrating concepts emphasized at this workshop, and it applies especially to institutions.

One problem with LMIs is partly that governments distrust or disparage them and find it convenient to work with organizations that they or their specialized bureaucracies can dominate and control. This makes such organizations automatically suspect and unattractive to local people. Another problem is that through factionalism, inexperience, or inability to discipline their leaders, organizations can fall apart because of mismanagement, internal conflict, or exploitation by an aggressive minority. This is why program developers should prefer to work with and through established structures that can depend on social solidarity and social control to discipline their leaders. Where such institutions are not available or seem unsuitable, newly established local organizations should be encouraged to incorporate roles and procedures that are familiar to the members and, where possible, be linked horizontally to other LMIs and thus benefit from their legitimacy. In Botswana Chris Brown reports that village development committees recently established under government auspices were greatly strengthened by compatible accommodation with the deeply entrenched kgotlas, headed by local chiefs who blanketed the new organizations with their legitimacy. When new organizations are formed at the local level, standard blueprints should be avoided. Equally avoided should be the command style familiar to national politicians and civil servants when they deal with rural people. Those who help to form such organizations should operate primarily as catalysts or resource persons, (not as promoters or managers), helping local people to launch their own organizations and to, develop and manage their own activities, so that members will not perceive them to be the creatures of outsiders--government agencies or political parties.

In the present African context, where the financial and management resources of governments are so constrained, little can be done to help low resource farmers without their active contribution and participation. For most activities, their contributions must be in the framework of local institutions accountable to their members. The co-production of services requires collective self-help--but through organizations that the members consider to be their own.

While objectively the LMIs may be weaker parties in linkages with outsiders, they must be treated as partners in an exchange relationship. These exchanges must involve both the tasks that will be undertaken and the methods by which they will be managed. In the absence of such reciprocity, members will avoid the tasks and may even abandon the organizations.

This section may strike the reader as a catalogue of don'ts. More positively it is optimistic about the participation of low resource farmers in membership institutions and their ability to work compatibly with donor assisted PVOs and government agencies--so long as there is genuine reciprocity. Members must be convinced that the institutions are theirs and that through them their interests are protected. Surely, this can be no surprise.

IV. The Implications of the Learning Process Approach for Low Resource Farmers

The learning approach implies some risks for low resource farmers in Africa, but fewer than any alternative for future development. Despite current expressions of interest--exemplified by this OTA workshop and the Congressional interest that prompted it--the most likely prospect for Africa's rural poor is continued neglect by governments and by donors. The current emphases on macroeconomic "structural adjustments" including privatization and marketization and on growing more food by encouraging "progressive farmers" and agrobusiness enterprises, are auguries of continuing neglect, relieved only in part by attention to the farming systems approach which, however, is still marginal and precarious in the priorities of both governments and of donors.

Continuing neglect may appear relatively risk free to low resource farmers but this is insidious in the context of rapid population growth and the exhaustion of the land frontier in Africa. Some small farmers may succeed in avoiding stagnation by their own individual initiative and learning process--by taking advantage aggressively of opportunities that may be open to them in production and marketing, but these also are not risk free. A few may catch on as outgrowers or full time laborers on agrobusiness estates and some may find ways to move into the ranks of progressive farmers with access to modern commercial inputs, finance, and marketing. In the absence of sustained technological, infrastructural and institutional improvement directed explicitly to their needs, the great majority will not succeed in increasing their productivity. They will be forced even more than in the past to seek off farm employment and migrate in larger numbers to the congested informal sector in overcrowded cities.

Another scenario calls for large-scale "modern" interventions introduced from the top down, designed to benefit rural people, about which they are not consulted but to which they are required to comply. Large scale social interventions such as villagization in Tanzania, or large socio-technical projects like ground nuts in East Africa and the Volta dam in Ghana, or the release and promotion of radical new technical packages or varieties--all of them designed and implemented without local consultation and in violation of the learning process mode--these surely entail great risk for the publics who are impacted even though the eventual outcomes may prove to be successful. The learning process approach seeks to limit risks by 1) initially narrowing the range of experimentation, whether social or technical, to a relatively few participants (combined however with a large number of interested observers) and then extending the innovation after it has been successfully tested and adjusted locally, and 2) involving local people in the experiments at the design and evaluation as well as the implementation stages. Incremental step by step progress by this route is necessarily gradual, but far more solid and far less risky to the great majority of low resource farmers than any alternative process of change.

V. The Log Frame and the Integrated Principles

As I read your paragraph five, it incorporates two questions:

A.) The first deals with AID's log frame. Any responsible foreign assistance agency must attempt to insure that, in addition to desirable goals, there is a reasonable prospect that the scarce means employed will produce visible and hopefully measurable social benefits over a reasonable period of time. The log frame is, in effect, a simplified model of PPBS or performance budgeting at the project level. The more the variables that affect performance are predictable and controlable, the more useful is the discipline of performance budgeting. In the framework of development assistance, say of an agricultural university, the physical construction phase of the project should be quite amenable to the log frame, since the variables are reasonably well known and controlable. So, but with less certainty, should be numerical and time-phased targets for admitting and graduating students. Much less so, however, would be modifications of curriculum and especially of teaching methods because they involve significant attitudinal and behavioral changes. Least of all would be the outputs of research activities because they are inherently uncertain. Any project oriented to changing behavior--of local bureaucrats, scientists, or publics--can not be convincingly blueprinted because of the prevailing uncertainties--too little is known about too many of the relevant variables to permit the kinds of detailed planning required by the log frame.

Any program intervention is a set of hypotheses about what is likely to work given certain expectations about the physical environment and the combinations of incentives and sanctions that determine human behavior. With most projects that deal with low resource agriculture in Africa, the local diversity is compounded by uncertainty--about soils and cultivation practices, legal rights to range, water sources, and even trees, availability of labor, marketing channels, food preferences, etc., etc.--all of which influence and some of which decisively affect performance. For most projects oriented to low resource agriculture, the log frame at best provides an illusory certainty; at worst it builds in rigidities that inhibit the necessary learning and adaptation both by host governments and by the donor agency itself. Unsuited to projects of this kind, it should be scrapped in favor of a simplified project justification and performance review instrument that identifies the problem addressed, demonstrates its saliency, indicates alternatives to approaching it, justifies the approaches (hypotheses) selected and the resources committed to it by the donor and the government. It should incorporate provisions for ongoing process and performance monitoring and for expedient adjustments to capitalize on the learning process. The quasi experimental nature of most interventions on behalf of low resource farmers in Africa, for example, farming systems research and extension, off farm micro enterprises, nutritional education and surveillance, group credit activities, etc., must be acknowledged in project design and management. This reform is complicated by the severe limitations in AID's field staffing and the disinclination of many contractors to rock the boat.

B. The second question relates the workshops integrated concepts to field operations: how can they be applied by foreign aid donors?

A number of field projects have begun to incorporate these principles, not surprisingly because these reflect the emerging state of knowledge. They need, however, to be better combined than they now are in most projects.

1. The participatory dimension is a good starting point. The burden of proof should be on any project oriented to low resource farming which does not incorporate farmer inputs of information, resources, or management, does not provide for their role in the operation and maintenance of

facilities, and does not deal with local institutions for facilitating their continuing participation. Any project oriented to low resource farming in a conventional top down, service delivery mode or which does not consider the possibility of co-production--a participatory and contributory role for the affected publics--should be regarded with suspicion.

2. Any proposed intervention--whether of technology, resources, or institutions--should be sent back to the drafting board unless it indicates that the project design has taken account of what is already there, of local practices and local institutions. The guiding assumption should be that the behavior of peasants is rational within the scope of their limited local options. Interventions should normally be incremental, building on what exists. When radical departures seem indicated--as they sometimes may, especially in the domain of technology--project design should have to outline the substantial net benefits and the distribution of these benefits as well as a process for introducing the innovations in ways that minimize social cost. These should require supportive evidence from field level experience or pilot studies.

3. The concept of institutional networks should be stressed. USAID and World Bank staff are promoting private sector and market based alternatives to government operations often with African governments which are less than enthusiastic. A more persuasive and indeed more effective approach to oversized and ineffective government operations would emphasize appropriate divisions of labor and linkages between government agencies, PVOs, local institutions, and the private sector on an activity by activity basis. There are many activities where government must continue to be the lead actor, (e.g., research, extension, roads, water supply, schools, etc.) especially in relation to low resource farmers. But

other institutions can and should participate to share the managerial and financial burden. In other activities the role of government can and should be drastically reduced--though not necessarily eliminated. The treatment of appropriate channels for providing services should be rescued from the ideological plane where it generates needless conflict and treated instead as a set of pragmatic issues emphasizing the utilization of all the scarce institutional and managerial resources that are available to improve levels of service at affordable costs.

4. During the past decade donor agencies have come to recognize the economic role of women in African agriculture. The services provided by African governments and the employment of women in providing these services to low resource farmers seldom reflect the weight of women in food production and food processing (70% and 100% respectively). There is much that donors can do to favor projects that explicitly reflect the economic role of women and thus increase the efficiency of public services oriented to agricultural production and marketing.

5. The site specific features of agricultural production call for large numbers of relatively small projects--though some large national and regional projects may continue to be required. Donor procedures have preferred large projects since they move money faster and at a much lower staff cost per dollar expended. One way to field small projects is through the development of intermediary institutions--governmental or PVO--that can accept substantial funds from donors and retail them as small scale projects to local communities or businesses with some technical assistance and reasonable financial and managerial controls. The strengthening of these intermediaries provides opportunities for donors to build indigenous institutions that incorporate the approaches to low resource agriculture

that are represented in this group of integrated concepts. Revision in the project approval and management processes set forth in paragraph A above can facilitate the management of small projects through indigenous intermediaries.

Notes on how these principles can better cope with Africa's development problems:

1.The problems of African small farmers are severe, long-term and deteriorating.

2.Salvation will depend on increasing the economic productivity of Africa's rural majority in ways that are sustainable and compatible with specific ecological variations. Therefore priority must be given to improving the capacities of millions of small farmers and herders to a)provide better for themselves, b)feed the growing cities, and c) purchase the output of new and expanding urban industries..

3.Prevailing development strategies have neglected Africa's greatest resource,_the skills, social structures and potentials of its rural majority, women as well as men. Governments and donors have misallocated and wasted resources through perverse economic policies, unproductive investments, and recurring expenditures that attempt to "deliver" services that are low in cost-effectiveness and fail to address the principal economic and social needs, capabilities, and preferences of rural producers.

4.The strategy underlying these principles represents a major departure from past practices.

a) It focuses government policies, programs and donor assistance on the productivity of small farmers as the major priority in African development.

b) It builds on existing indiginous systems of knowledge, practices, and institutions.

c)It fosters, supports, and activates local initiative and self-help in identifying and addressing opportunities for increased productivity and quality of life under specific local conditions.

d) It mobilizes all available organizational resources including the private sector into service networks to strengthen the productivity of the small farm sector.

5.Thus the overriding goal is to increase the economic productivity of the previously neglected rural majority which is essential to long term development in Africa. Among the means are improved and more relevant services in which rural publics participate not as passive recipients of the modernizing ideas of outsiders, but as active contributors and coproducers. This shifts the role of rural producers from the neglected periphery to the center of development activities.

Contract Paper No. 5

FINAL DRAFT

LOW-RESOURCE AGRICULTURE IN AFRICA

INCORPORATING PARTICIPATORY APPROACHES IN INSTITUTIONS

by

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December 1986

FINAL DRAFT

Low-Resource Agriculture in Developing Countries:
Implications for Africa
Incorporating Participatory Approaches in Institutions

Report Prepared for
Office of Technology Assessment
U.S. Congress

by

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I. THE PROBLEM

A. Present Situation.

(1) Because of the alarming statistics currently being circulated and discussed concerning sub-Saharan Africa's agricultural production, natural resources, and economy, there is a growing recognition that normal project aid inputs are not sufficient to meet the hunger emergency. For instance, the rate of growth of the GDP per capita for Africa was 1.3% per annum in the 1960's, but dropped to 0.7% in the 1970's, and has averaged -3.7% since 1980. Agriculture contributed 47% to the GDP in 1960, but only 33% in 1982. The trend of annual grain production per capita 1970-1984 in 24 countries shows a decline of 2% per year (World Bank;1984). Environmental degradation through the continent-wide loss of vegetative cover and degradation of soils is placing stress on natural support systems throughout the continent (Brown;1985). The problems are multiple and complex, and the wholestic and integrative institutional problem solving capabilities of both national and international are low.

(2) Given the decreased productivity of African agriculture, it is not surprising that the international aid community has been discussing the need to develop new programs that emphasize the subsistence farming and local production economies. In these discussions there is increasing evidence of a new awareness and interest in the need to define and build upon local resources and local management at the community level. The message that has emerged from the accumulated experience of over twenty years of economic development assistance is loud and clear:

—Projects don't work unless the local people are actively involved in the design and implementation of the government and donor programs that effect their community.

—Programs don't last unless the planned inputs, incentives, and activities are linked to resources that already exist in the community.

(3) Despite the clarity of this message, and even though most donor agencies claim commitment to participatory approaches, few programs or projects attempt to provide assistance in ways which respond to local needs while building local organizational and technical capacity. The lack of substantive interest in this approach has been caused, to a great extent, by the continuing economic and institutional bias towards projects that emphasize measurable inputs and operate efficiently within the confines of the traditional institutional bureaucracies presently operating at both the national and international level.

(4) Now however, the extent and duration of Africa's emergency is creating a new awareness. This new focus recognizes that valuable information and experience rest with the local people, and that valid mutual partnerships through linking organizational systems must be formed between the local people, the project and supportive organizations to tap these resources.

B. The Emerging Consensus

(5) "Growth, equity, well-being, and participation" were adopted as goals for development during the mid 1970's without corresponding changes in organizational structure or procedures. The result was increased discussion and dissension within development organizations and institutions on whether "top-down" planning, in other words business as usual, which regarded the local

people as beneficiaries was sufficient, or whether "participatory" strategies, which regarded local people as active participants, necessitating changes in organizational structure and process, was necessary. Initially, the "top-down " advocates seemed to have all the arguments on their side. However, hard-earned knowledge gained over the past ten crisis years in Africa indicates that the top-down advocates were only correct about the last assumption, and decidedly wrong about the first four. Assumptions and realities are compared in Figure 1.

(6) At this point many people and institutions, who even five years ago thought participation was extraneous to the real work of development, are now discussing the need to work with local institutions and local people. The past ten years, drought and crisis ridden as they have been, have forced a re-assessment of assumptions and realities about both the existing structure and complexity of African production systems, and the needed changes in structure that international and national development institutions need to undergo to assist in the creation of sustainable development. The increased understanding of existing realities and the subsequent refocusing of the central issues establishes a base for an emerging consensus.

C. Summary

(7) The major premise of this paper is that the central focus for every development organization, whether national, local, or international, should be the community participation process at the local level. This does not mean that all institutions should become grassroots development organizations—that would be clearly ineffective and inefficient. What it does mean,

Table 1:

"Top Down" Assumptions and Emerging Realities

for Development Projects

Argument	Assumption	Realities
There was little or no knowledge or management capacity to work with at the community level, therefore anything but top down strategies were a waste of time;	Because physical and material resources within African rural communities are so minimal and even primitive, it is assumed that information and managerial resources are also limited or non-existent at this local level.	The argument and assumption have proven to be incorrect. The increased knowledge of the micro-environments of Africa has brought into focus the large amount of substantive knowledge about preferred production methods and local management systems that exists at the community level with the small farmer.
Top-down measures saved time because project managers had to deal only with designated community leaders who were all male and easily accessible for meetings and consultations.	There was no need to consult women about agricultural production because they were only passive beneficiaries of development whose powerless status would in time be raised as their forced workloads decreased because of improved technologies.	The argument and assumption have proven to be incorrect. Women are now recognized as principal custodians of Africa's food systems. They manage the available agricultural, water, and fuel wood resources to meet the needs of their families and communities.
African communities could and would automatically develop socio-economic systems, based on simple market economics, to manage and maintain new technologies that contributed to increased quality of life.	The traditional production systems of Africa that focused on individual hard work and diversity of productive undertakings, but negotiated communal sharing of production, were an anachronism waiting to be replaced by the market economy.	The argument and assumption have proven to be incorrect. Early encouragement of African farmers to adopt the mono-culture production of one or two cash crops has been found to be devastating to the fragile environment, and the merits of the traditional method of a complex mixture of crops, livestock, and trees is now increasingly recognized.
The important goal of "participatory bottom-up" strategies was political power for the rural masses and discussions about people participation for development was rhetoric and unimportant to economic development at the local level.	The advocacy of these participatory strategies was politically motivated by leftists, or "liberals" who did not understand they were being manipulated for political reasons.	The argument and assumption have proven to be incorrect. Problems with sustainability after project resources were withdrawn have strongly illustrated that when local people were not involved in the planning and decision making, the new interventions were not used or maintained and the projects failed in the longterm.
Participatory programs would be more time consuming, difficult to manage and oversee than the current top-down, replicable projects..	Participatory programming was incongruent and inconsistent with existing organizational processes and procedures.	The argument and assumption have proven to be correct. Participatory programming does take more time and requires different management skills. For successful incorporation of participatory approaches, new organizational processes and procedures must be created.

however, is every institution's organization and operational procedures should be designed so that it can support the local participation process at whatever level the specific organization is responsible for.

(8) The key issue for local level organizations is to devise participatory processes that begin to assist people in assessing information and making decisions, and taking responsibility and control—and therefore power—that enables them to evolve and sustain needed interventions and programs. The hard question that donor and national agencies have avoided until now in the participatory process is how do outside organizations come to terms with the power sharing that is implicit in sustainable projects at the local level, and what are the implications in terms of longterm organizational policies and short-term operational policies and short-term operational procedures.

(9) The following sections of this paper attempt to describe a specific "how-to" methodology about how these power sharing participatory linkages can be actually put in place and used at the organizational and institutional level. This participatory management model, referred to as the 'Local Management Participation Process' (LMPP) addresses the "power" issue by providing a "replicable model" that donor agencies can utilize as an operational guideline for power sharing and capacity building leading to sustainable development. Implications to organizations of the changes required are specifically discussed and difficulties acknowledged. The need for a critical assessment and resulting fine tuning of certain areas of U.S. legislation and executive agency polices are briefly reviewed.

II. HISTORY OF PARTICIPATORY APPROACHES

(10) The emerging consensus, briefly described in the preceding section, throws into stark relief the fact that the needed theory, analytical, and management skills to create more participatory institutions may exceed our present capacity. At this point a brief history of efforts to institutionalize participatory approaches, and lessons learned, is appropriate.

A. Participatory Approaches

(11) Initially, development of participation as a theory and operational methodology contributing to change and development was not thought to be necessary. This was because participation was primarily viewed as a mobilization process for communities on the road to modernization. In this situation, choice of participation technique or method was dictated by the overall development assumptions of the staff or organization, rather than a substantive operational understanding of how or why successful change took place.

(12) For instance, local leadership techniques use "from the top down" directions and were first seen in the early community development and animation rurale techniques used by the British and French colonialists in the 1950's. Here the ultimate development objective was modernization through economic objectives and the development philosophy or ideology emphasized outside "inputs" because it was assumed that the new development community would follow the footsteps of their "more advanced" western cousins. On the other hand, the "problem posing" and "participatory research" methodologies emanating from the adult and non-formal education theories of Paulo Freire (1970) and Julius Nyerere (1968) used a bottom up direction. Here the ultimate development objective was building of community capability and control through

learning, decision making, and responsibility. Implicit in this focus was that there had to be a 'hands-on' inter-action between knowledge from the outside and knowledge from the community, or inside, culminating in improved production systems that met the specific needs of the community and region. However, for a number of years the political overtones of the "problem posing methodology" overshadowed its contribution to the theory of participation and understanding of economic and social development.

(13) In the past 35 years five different "participatory" approaches have been extensively used by various development institutions. Each of these approaches are variations of two basic theoretical approaches to social change--"input" based on top down strategies, and "process", based on bottom up strategies. Table 2 classifies these strategies.

C. New Learning Theory Frameworks

(14) The development of theory, analytical and management skills to create more participatory institutions has, therefore, been a long and arduous task. Presently we are in a period where the tremendous interest about participation over the past ten years has yielded a variety of analysis and theory.

(15) Two of the most complete studies to be undertaken are the UNRISD program on the theory and practice of participation launched in 1979, and the USAID funded work of Cornell University's Rural Development Committee on "rural development participation begun in 1976. The UNRISD enquiry purposely kept the definition of participation rather broad to include the idea of political participation, while the Cornell group chose to focus on participation in the context of economic development projects.

(16) Analysis of the basis of participation by Cohen and Uphoff of the Cornell group (1976) was extremely helpful in removing the theories of

Table 2: UTILIZATION OF PARTICIPATION STRATEGIES

History	Objectives	Organizational Requirements	Methods
"Community Development" was first formulated at the Cambridge Conference in 1948. Major emphasis was in India. Programs were operating in 60 different countries by 1960. Community development strategies lost favor as donor agencies focused on urban sector and institution building in 1960's.	Modernization and economic developmnent of self-reliant rural communities used by gov'ts. Derivation used by PVO's	"Top down" planning and implementation in centralized organization in cooperation with local communities	Method was focused on a Ministry employee who helped a community plan and implement government decided upon development goal. Critical assumption was that national government and community shared same goals and all community needed was "inputs" and one-way Technology Transfer. No focus on women or integrative agricultural strategies
"Animation Rurale" was development by the French for Franco-phone Africa during the same time that "Community Development" was being used in Anglo-phone countries. Several journals, including Tiers Monde, published extensively until 1975.	Modernization, development of the nation state, and economic development of self-raliant rural communities used by gov't. Derivation adopted by PVO's	"Top down" planning and implementation in centralized organization in cooperation with local communities	Method was focused on an effort to get villages working with the national government on development efforts. Village selected farmer was sent for training to become "animateur". He was expected upon return to the village to engender grass roots response to national development efforts. No focus on women or integrative agricultural strategies
Problem Posing Methodology and Participatory Research was first formulated in Brazil by Paulo Freire. Later was joined with Julius Nyerere's descriptive theory in Africa. Was begun in the 60's and enjoys continuing and growing influence in the 80's.	Building of community capability and control to increase productive development and quality of life. Local NGO's have been most successful	"Bottom up" planning and implementation in participatory institution or "learning organization"	Method was focused on a process through which local people become aware of their own power, look critically at their own community situation, and take steps to change that which is judged negative. Strong focus on women as participants and integrative agricultural strategies based on local knowledge

Table 2: UTILIZATION OF PARTICIPATION STRATEGIES

History	Objectives	Organizational Requirements	Methods
Non-Formal Education is presently used as a low key development approach in many African countries. It is viewed by some as a failed effort to bring together a top-down Integrated Rural Development (IRD) focus with the more difficult to manage bottom-up problem posing methodology	Teach the nature and process of technical and social changes in rural development. Used by Gov't., PVO's, and donor agencies	Either no requirement or assumes that it can sensitize hierarchial organizations to need for bottom-up strategies	Method was on the development of lifelong learning systems designed to provide all individuals with a flexible and divesified range of useful learning options, outside of the formal education system that are linked to needs and processes of national development. Over time increasing focus on women and integrative agricultural strategies
"Rural Development Participation" (very similar to Integrated Rural Development) was outgrowth of "New Directions" that focused on equity and rural development concerns. It has contributed substantively to theory and awareness, but actual implementation is usually a failure because organizational procedures do not support philosophical tenets.	growth, equity, and participation. Used by donor agencies, PMU's and int'l. PVO's	Administrative decentralization to work with local organizations but "top down" planning and implementation still permitted at decentralized level	Focus is on administrative decentralization and movement away from top-down centralized ministries. The importance of working with local organizations is recognized; and emphasis on integrated nature of problems along with need or organizational linkages between local and national institutions. Strong focus on women as beneficiaries only and need to integrate "agricultural services"

Freire on learning and development from total association with political movements. They focused on the impetus and motivation for participation. Impetus is characterized as either coming from "the bottom up", or "from the top down", while motivation is seen as a continuum from voluntary to coercion. The bottom-up participation is seen as more likely to be voluntary, while the top-down participation is more likely to have elements of coercion.

(17) The most recent research notes from UNRISD (1985) notes as one of its general conclusions that successful organization and action at the local level "seems to depend crucially on knowledge and assessment" of the array of forces and obstacles that actually face the people in their efforts to participate.

C. New Field and Organizational Frameworks

(18) In the past ten years there has been an increasing learning focus in efforts to understand the working of participation at both the organizational and field project level.

> (19) The recognition that development, even economic development is essentially a knowledge process has been slowly penetrating the minds of economists, but we are still too much obsessed by mechanical models, capital income ratios, and even input-output tables, to the neglect of the study of the learning process which is the real key to development. Boulding (1971)

(20) A growing number of social scientist have begun to describe the effects or functions of participatory approaches at the field level. Racellis (1973) describes six modes or structures participation that range from consultation with selected community representatives to people having majority representation on a decision making board. Her focus is that the structure utilized, and its capacity to incorporate capacity building and power

sharing, is the dominant factor in determining the amount of involvement by the people and the ultimate success of the project.

(21) At the organizational level a "Learning Process" approach to rural development and community organization for organizations was elaborated by Korten (1980) as an alternative to the traditional "blueprint" type of institution. He suggests the creation of organizations that can be responsive and flexible— through embracing error; planning with the people; and linking knowledge building with action.

(22) Participation as a learning process at the local level and its necessary elements has been discussed by Donnelly-Roark (1979; 1984). She defines participation "as the learning process by which communities control and deal with change and development". The necessary components for this learning process to successfully operate is recognition of local management systems, establishment of two-way information systems, and recognition of local control by the outside agencies that want to work with the community.

(23) Finally, the "fit" between management systems and task was explored by Ickis (1983). He asserts that we presently have development institutions using the same organizational procedures that were put in place more than 25 years ago to implement growth and welfare strategies. The new strategies required to meet the development goals of "growth, equity, well-being, and participation" are more complex and diverse and therefore require new organizational structures.

D. Summary.

(24) Recognition that participatory approaches must be considered as more than mobilization technique has emerged slowly and with difficulty. This is because participation as mobilization, used in community development strategies and to a lesser extent, rural development participation, is

comfortable and manageable for institutions: it allows them to focus on input strategies that fit in with blue print top down organizations. Participation as a learning and decision process for communities and local organizations, used in the problem posing methodology, is stressful, and to some extent threatening to development institutions because bottom up participatory strategies means sharing power and ultimately changing the institutional structure of our organizations.

III. PRINCIPLES AND CONCEPTS

(25) Principles and concepts that relate specifically to the development of participatory approaches for development institutions that deal with low-resource agriculture are specified below.

A. Definition of the Problem

> (26) Principle: Neither the multi-faceted, but isolated subsistence production system of traditional Africa, nor the western economic system of industrialized countries, developed for sturdy physical environments that could withstand the crude but effective stimulus of supply and demand, is presently adequate as an African vehicle for expanded economic and social development.
>
> (27) Concept: Because of the fragility of the African ecology and environment, production systems must be more integrated and wholistic than those demanded by temperate climates. Therefore market systems that are more complex and sensitive to the needs of the fragile environmental systems must be developed and fine-tuned. The development of such systems must start at the local level.

(28) Our present Western market systems are based on the "invisible hand" assumption that assumes decisions reached individually will in fact be the best decisions for an entire society. However, because of the fragility of its environment, Africa at this point can be compared to the "commons" that was destroyed by the herdsmen who each tried to rationally maximize his/her own gain (Hardin:1968;1984).

(29) Therefore, market systems that incorporate "social arrangements that produce responsibility" of the sort that Hardin advocates are absolutely necessary for longterm improvement. African cultures are past masters at these types of social arrangements that produced responsibility for the environment while providing for survival, and derivations of these systems

should be regarded as incomparable resources and incorporated into the emerging market systems.

B. Establishment of the Necessary Process

(30) Principle: Community participation is defined as the learning process by which communities deal with change and development and undertake the process of incorporating new knowledge into their existing local management systems.

(31) Concept: Incorporation and control of knowledge through participation, needed for continuing management of changing resources, always necessitates three preliminary components: recognition of local management systems; establishment of two-way information systems; and community control of resulting decisions, referred to as the "LMPP".

C. Identification of the Key Players

(32) Principle: Local management systems exist for every production activity that is undertaken by community members. These local management systems are usually subsets of the cultural and political leadership of a community and therefore include the working people, men and women, who actually do the work and make the everyday management decisions concerning the production system they re responsible for.

(33) Concept: Local management systems, as well as national and international organizations, must be involved in the conscious refashioning, through community participation processes, of local production systems, which includes food, livestock, water, and trees. projects.

D. Model for Necessary Institutional Change

(34) Principle: New goals of development that focus on participation and partnership strategies require new process and operational procedures for development institutions and organizations.

(35) Concept: Agencies, both at the international and national level must reorganize bureaucratic processes and procedures to be flexible and congruent with local participatory processes and their outcomes, and inter-active enough to form two-way linkages with existing local organizations and management systems. The "Local Management Participatory Process", provides organizations with a replicable focus for project design and implementation, while at the same time it confronts and deals with the power sharing issue.

IV. CREATING AND ENHANCING PARTICIPATORY APPROACHES IN EXISTING INSTITUTIONS

(35) The key element of success at this point in time for developing participatory approaches in institutions is the willingness by organizational directors and staff at national and international levels to fully accept the need for the participatory process at the local level. Rhetorical acceptance, of which there is a great deal now, is no longer adequate.

(36) This full acceptance of the participatory process should focus on the fact that local control is a necessary and positive part of sustainable projects.

A. Alternative Organizations and Types of Participation

(37) Replicability is essential to any bureaucratic organization, and top down operational procedures seemed to be an essential part of successful programming even as the need for participation was increasingly recognized. Therefore a great deal of time, money and energy has been spent in looking at "alternative organizations" that attempted to integrate "top down" planning and implementation with "bottom up" participatory strategies. Table 3 describes the strengths and weaknesses of the various "alternative organizations" in terms of creating sustainable projects. An assessment of Table 2 and Table 3 indicates that efforts to combine bottom up participatory strategies in organizations that retained top down planning and implementation control has been a failure because the need for "local control" was not acknowledged or acted upon.

Table 3

Alternative Implementing Organizations[1]

Organization	Strengths	Weaknesses	IRD Experience[2]
Project management units	Able to bypass onerous financial management systems Often concentrates authority and delivers goods and services Is effective for infrastructure construction Sometimes is insulated from political upheaval Can focus on specific renewable natural resources and technical areas Usually provides donor with greater financial control	Is unable to pick up recurrent costs Does not build capacity in permanent institutions Tends to try and perpetuate itself as an organization Can be vulnerable to encroachment of line ministries Competes with permanent institutions for scarce staff and usually offers highly paid temporary non-career positions	The most common IRD implementing organization, the PMU, has proved to be highly effective for physical production, but it seldom succeeds in building local capacity to carry on. It exemplifies a bypass approach and generally avoids control-oriented administrative systems by staffing with expatriates and establishing independent administrative procedures. Theoretically, it provides a flexible temporary environment supportive of experimentation, but in fact this seldom happens.
Subnational government bodies	Can pick up recurrent costs as a permanent institution Builds capacity in permanent institutions Usually has strong horizontal linkages Uses existing socio-political boundaries Often links planning and implementation	Is difficult to use in small countries with poor human and institutional resource bases Often is vulnerable to encroachment of line ministries Often serves local elites Multiple subprojects may be difficult to manage	This approach often uses subprojects as learning laboratories to build local capability. Planning and implementation are thus merged. Decentralization is usually stressed, but local officials are often suspicious of national intentions. Mixed signals can stifle implementation when rhetoric emphasizes learning, decentralization, and capacity building, but incentives, finances, and evaluations are geared to physical production targets.
National line ministries	Can pick up recurrent costs as a permanent institution Builds capacity in permanent institutions Has strong professional and technical orientation	Personnel attracted from other ministries create difficult management situation Delegation of authority is often lacking May be hampered by national politics May ignore local differences	When a multisectoral (IRD) job is given to a sectoral ministry, it usually leads to complex interorganizational relationships that are hard to manage. Although theoretically the approach provides clear lines of authority, in practice skilled managers are needed to contend with coordination difficulties. When the rhetoric of integration is mixed with multi-agency staff, a reluctance to set priorities and deal with different components sequentially tends to develop.
National IRD agencies	Can facilitate vertical integration of local and national objectives Can be structured to augment other institutions Can provide access to top-level decision makers	Often has conflict with line ministries May duplicate other institutions' functions May ignore local differences May be difficult to manage because of geographic dispersal of subprojects	This is largely a Latin American phenomenon, but a version has been used in low population countries of Africa. Parastatals with a multisectoral mandate are a variety of this model. Administrative redundancy and high conflict characterize one variant of this approach. A second pattern fills gaps but risks supporting technically weak subprojects.

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1. Honadle and Van Sant, 1985

2. IRD: Integrated Rural Development

Table 3 (Continued)

Organization	Strengths	Weaknesses	IRD Experience
Private voluntary organizations	Can address micro-level needs and variations Can mobilize private resources Can stress capacity building at local levels Low profile insulates it from political battles and avoids predators Emphasizes informal processes and local role in decisions	Often lacks legitimacy and is viewed with suspicion Has little leverage Is limited to small areas Is sensitive to quality of personnel Has little access to top-level decision makers Often has low technical quality Often has little effect on formal system	This is a contemporary multisectoral descendant of community development. It uses intermediate technologies and group dynamics as tools for self-reliance and sustainability. The integrated focus is at th community level rather than at the administrative level. In many cases, however, the PVO presence acts like a mini-PMU, with similar failings when the external resources are withdrawn.

Table 4: Typology of Community Participation

1. Unofficial representation by a "solid citizen" group which endorses outside-planned programmers
2. Official appointment of local leaders to positions in government bureaucracy.
3. Community's choice of final plan among pre-determined options
4. Ongoing consultation starting with plan formulation
5. People's representation on decision-making boards
6. Community control

Adapted from Racellis, 1973 and White, A. 1984

(38) It is now recognized that certain levels of intensity and type of participation are needed if local control is to be a viable option for communities. Types and intensity of participation are illustrated in Table 4. In this typology, levels 1, 2, and 3 are not sufficient to involve the community because they do not offer the possibility of control. Levels 4, 5, and 6 do offer shared power/local control, dependent upon community capabilities. The first three options are those that are usually offered by projects, while the last three are difficult to implement and sustain without a supportive bureaucracy.

B. "How" Is The Question.

(39) Three necessary conditions for successful participatory processes at the local level are defined and how-to strategies are briefly discussed here in terms of project management at the local level, country mission or national level, and international headquarters level. These three necessary conditions are not culture specific and therefore this adds to the probability of wide organizational use. The three necessary conditions are identification of local management systems, utilization of two-way information strategies, and acknowledgement of need for specified areas of local control.

(40) This Local Management Participatory Process (LMPP) defines the processes that are necessary for sustainability in every participatory project. It establishes a replicable model of the participatory process that can be used by development institutions as they establish new operational procedures that are congruent and supportive of project power sharing and increasing local control.

(41) It should be noted that the commitment to, and establishment of new operational and organizational procedures that allow for power sharing are the key steps that will allow participatory projects and partnership

strategies to grow and flourish. The needed overhaul of development bureaucratic structure is now a possibility and viable, rather than rhetorical, partnership strategies are long overdue.

1. Local Management System Focus

(42) When a new visitor enters an African village for the first time, he or she is often struck by the minimum levels of physical resources, such as easily obtainable water and firewood, and the total lack or paucity of material goods and often therefore assumes that natural resource management skills are rudimentary if they exist at all. If the visitor stays for any length of time, there begins a slow accumulation of experiences that in time allows a person to recognize the complex and well developed information, resource allocation, and local management systems that has enabled the community to continue to exist, grow, and sometimes thrive, under the most difficult of physical conditions.

(43) These local management systems are usually subsets of the political and cultural leadership of a community, and therefore include the working people, men and women, who actually do the work and make the everyday management decisions concerning the production systems they are responsible for.

(44) The need to build upon the local knowledge and expertise available at the community level for successful projects and programs that are maintainable and sustainable is now a strong message at the policy level. At the operational level it has become increasingly clear that the traditional and local systems of management, resource allocation, and information and learning, must be the focus of any effort with African farmers and herders to increase agricultural and livestock production.

- "How-to" strategies to define local management systems.

1) Definition of local management systems will entail a number of meetings at the community level. A good

way to begin is to hold meetings with the chief or elders and then ask to meet with the people who are doing the work in the agricultural sector.

(2) Focus on Local Management systems are a key point in terms of the involvement of women. In many community meetings when people are asked "who" is in charge of certain production decisions, the answer almost invariably identifies male political or cultural leaders. But if questions are rephrased focusing on "how" production decisions are made, answers, such as "the women take care of that", or "the young men are responsible for that", begin to outline the existing local management systems. For those areas where traditional communal orientations have begun to break down or did not exist to begin with, the same "how" focus helps to define responsibility and power within the household and extended family production systems.

(3) Once the specific local management systems has been identified exchange of information begins. In time this will be the same group, along with local leadership, that will be asked to make decisions. The first decision to be made after preliminary exchange of information is whether the community wants to be part of a broadly defined project.

(4) Two areas of expertise come together in local management groups 1) technical knowledge in terms of agriculture, water, herding, and forestry; and 2) the distribution and mutual reciprocity network that helps preserve the environment. Mutual sharing of information with project people allows both groups to design a sustainable project. These activities start in Project Planning stage and continue through the Project Start-Up Phase.

2. Two-way Information Strategies

(45) Development of successful methods of communication between project and community is the key component to successful partnership in the short term, and sustainable interventions in the long-term. Two-way information systems allow the project to become familiar with existing local knowledge and resources, perceptions of acceptable risk, conflict and resource inequity within the community, and assessments of inter-dependencies of production systems by the local managers themselves.

(46) At the same time, the local management groups can obtain information on all the options available to them, the implications of the proposed changes—including financial costs, impact on existing cultural customs, and changes, including increased skills, needed in existing management systems to maintain and sustain the proposed intervention. It is important to emphasize that the focus of this two-way information strategy must be on the local management system, and not the political or cultural leadership. Otherwise information obtained will be skewed towards a male and elite point of view, and not reflect the community or local management groups at large.

(47) It is surprisingly rare for communities or projects to obtain this kind of information before program implementation is actually begun. Too often, preliminary decisions are made at the design level by the donors with little or no consultation at the community level. Often, the expatriate team will assume that one specific factor, such as increased food production, or increased quality and cleanliness of water, are the most important areas of achievement for the community. The community on the other hand, must consider whether the agricultural changes or water improvements will be reliable and diversiable under stress, and will serve them in the long-term.

(48) Sometimes project teams can do incalculable damage with their linear and unknowingly arrogant advice to farmers who take their information at face value. For instance, the farmers of Niger no longer grow peanuts as cash crops in many areas. During the late seventies and early eighties the farmers rapidly adopted new varieties of peanuts and abandoned the indigenous varieties. This boosted peanut production for awhile. Unfortunately the new variety, which was already fragile, developed an incurable disease and farmers lost their entire stock of the new variety. Now they are cultivating other types of cash crops.

(49) At this point it becomes apparent that "access to information", upon which two-way information strategies are based, is not a simple and straightforward process, but rather it is one of great complexity because of its relationship to control of knowledge and resulting community control of development decisions.

- "How-to" Strategies to implement two-way information systems

  1) Two-way information systems are relatively easy to start if the Project has access to social scientists that have been trained in community participation techniques of high intensity and involvement. However, it is much more difficult to use the information effectively.

  2) The Project Manager is the key person in utilization and effectiveness of the two-way information through appropriate timing. Only he/she can set project schedules so that project inputs and community inputs are equally weighted and scheduled appropriately.

  3) Correct scheduling of the appropriate technical and social factors—such as participant choice/input into technical package or technology used is dependent upon having operational procedures that support participation. Project staff is often unable to control this, and if the community sees their perceptions being disregarded, the information systems will fall apart.

3. Local Control Approach

(50) The objectives and actions of most agricultural and livestock projects that hope to help farmers and herders increase production and improve their living status have been, as discussed earlier, based upon the implicit assumption that in due time Western methods will be recognized as better than the existing community methods, and the required change will take place. This wholehearted adoption of new standards rarely happens, and when it does it is usually found to be short lived, to the dismay of returning project evaluators. A more successful approach is one that allows and encourages integration of new

information with existing community knowledge, precipitating a community or local management system reformulation of methods and habits by the community.

(51) This is not an easy process. First of all, the introducer of these new methods and technologies must understand the responsibilities involved in asking communities to consider changing long standing traditions and customs that have been perceived as adequate for long periods of time. In addition, the locally perceived risk factors should be recognized as a possible obstacle to involvement for the poorer farmers, and arrangements negotiated to minimize this obstacle. Indeed, these perceived risks should be discussed and analyzed carefully because they often offer assessments of what will really happen to the intervention in the long-term. Finally, the introducers will also be obligated to recognize certain levels of local control in order to create and preserve the partnership necessary for success.

> (52) "Observations of local management systems at work as they undertake the process of incorporation of new knowledge, indicates that the control of knowledge through participation, needed for continuing management of changing resources always necessitates two preliminary components: access to adequate information, and community control of resulting decisions" (Donnelly-Roark; 1984).

4. Linkages Between Local Control and the Environment

(53) When the phrase "local control " is first used, many development professionals immediately shudder as they imagine turning over the project accounts and car keys, and see all viable organizational control and accountability stripped from them. But these are not the essential areas of control for the local management groups. For them the area of interest is in all decisions concerning sector technology and management systems.

(54) A key point here is how change and development actually takes place in communities. Earlier in this paper participation was defined as the learning process by which communities control and deal with change and

development. Therefore participatory institutions and projects must be flexible enough to allow local management systems the right to control their own production mechanisms. If they can't control it or if it doesn't meet their specifications they will refuse to maintain the new intervention.

(55) Perhaps even more important is the link that local management systems offer between production and preservation of the environment. Each of the traditional local management systems incorporate into their traditional decision making process criteria that serve and balance both production objectives and preservation objectives. However, if the local management systems are not given adequate information and control of new inputs and new technologies the necessary balance begins to break down. In Africa, we are seeing this happen every day.

(56) For instance, agricultural projects often make the grave mistake of advocating new types of seeds that may not turn out to be as hardy or as disease resistant in the long-term, or they may advise the concentration on a single crop monoculture which allows insect pests to flourish because of lack of natural balances which formally kept insects under control . Farmers need to keep control of these decisions and decide the types of technology that meet their criteria for both short term production and long term survival. The need for local control is found in all sectors.

(57) A good example of needed local management control is the type of technology needed for a new water point. Most project engineers assume that the hand pump is the lowest level of technology that should be installed, while the preferences of a women's local management system, because they defined reliability as their major concern, and realize that mechanical systems always break down, should also have the right to consider an improved modern hand dug well that can be operated with rope and bucket

(58) Local management control of projects that build new water points in fragile agro-pastoral lands should be considered an absolute necessity, but in fact,never happens. Installation of new water points have contributed immensely to destruction of marginal land in Africa basically because they are open year round and therefore undermine the traditional rotation systems that kept herds moving and gave the land time to replenish itself. If the existing agro-pastoral local management systems were given the negotiated rights to close certain wells at certain times of the year, the water from the new wells would become a resource that could expand agro-pastoral production over the long-term, rather than a short-term resource that quickly destroys a fragile environment.

(59) This need for local control will obviously be a limitation that project implementors and designers have not often recognized or explicitly dealt with in the past, and will often be tempted to try and overcome in the future. However, the awareness that this limitation does exist, coupled with the acknowledgement that it is difficult to integrate 'local control' into the operations and procedures of the project and its funding organization, should lead to increased study and analysis of both organizational operating procedures, and local production systems. In time, the community process of deciding whether or not to adopt or adapt certain new types of technology and the project process of matching technologies to community criteria will become easier for both sides.

(60) "How-to" Strategies for Local Control

1) Community must have choice of whether to participate in project. Therefore it is best to make possible project area bigger than that which project actually works with.

2) During Project Planning and Start-Up, community and project should mutually negociate types of control points that are open to change. There may be some areas that are not open to negotiation from the

Project point of view, or visa versa and these should be identified.

3) Women are often the controllers of specific local management systems such as water supply, food production agriculture, and forestry. It should also recognized that women are often the leaders in the social networking that is put into gear when drought or disaster hits.

4) Advocating local control can be compared to watching the desert bloom after its first spring rain—the richness and diversity of color in the first instance, and the richness and diversity of capacity in the second—is an unexpected delight.

4. Summary

(61) There is a stereotype that many donor agencies still ascribe to that participation is too expensive because it is people intensive and makes the project implementation phase last longer. This stereotype is being challenged on all sides, specifically in terms of long-term sustainability as opposed to the trade-offs of short-term implementation efficiency.

(62) In any case, it is now time to begin to look at the cost-benefit analyses of participation. A vast array of anecdotal information refutes the notion that participation is not cost-effective, but it is now possible, and time, to put it in these more quantitative terms.

C. Who's Doing What Now?

(63) The great majority of development projects and programs over the years have been initiated and executed by the national government in cooperation with a multi-lateral donor such as the World Bank or FAO, or bilateral donors such as USAID or Swedish International Development Agency (SIDA). At this point, this type of alliance is generally assessed as too cumbersome with its focus on top-down strategies to be successful. The search to find other groups who are more successful is now a high priority and there is much discussion about international and national PVOs.

1. International Private Voluntary Organizations.

(64) The increasing realization that local issues and local involvement are crucial to project and program success has recently led to an increased interest in the role that international (PVOs) could play in implementing programs at the project level. Many people and organizations are emphasizing the idea that international PVOs, because of their grassroots experience should become the major initiators of projects at the local level, because they are viewed as the most successful. However, the facts do not necessarily bear this popular assessment out.

(65) A recent assessment of PVOs by USAID in 1982, according to Yacoob (1986) suggests that:

> "prevailing assumptions about what they-(PVOs) do and how well they do it are often erroneous. These assumptions—that PVOs are effective at innovating, operating cheaply, reaching the poor, and ultimately getting their target groups involved in the process—come from claims unconfirmed through testing and research.
>
> In fact, this evaluation went on to conclude that PVOs are not reaching the poor majority, or bottom 40 percent. Neither are their projects participatory since the hallmark of their administration is top-to-bottom control and decision making by local elites. And what is often confused for innovation is the PVO's adroitness for extending a known service to a previously uncovered population (1986:12).

(66) PVOs have had real successes with certain projects. Each international PVO has one or two projects which have been cited in various reports as having strong elements of success. For example, Lutheran World Relief has a successful hand dug well construction project in Niger; Catholic Relief Services has silk worm production with Egyptian women; while Care has a community based forestry project in Niger. An aura of success has translated itself to these organizations themselves because of these real, if few, field

successes, and also because it is now realized that their grassroots focus is a necessary and correct one.

(67) Field based observation in Africa suggests that every PVO success is based upon three factors:

—long-term commitment to a place and program;

—knowledge and use of participatory processes;

—short term accomodation of operational procedures;

(68) However, the focus of these factors are not based in the organization itself but in the personality of some of the people who work for the organization and were willing and able to change the rules. Therefore, international PVOs will continue to have its share of successes and its share of failures, dependent upon the personality type of people who work for them and how flexible and easily the organization will change to meet the demands of these personalities and the projects they work with. However, this is not an adequately replicable situation for widespread and long-term development initiatives. In other words there are successful participatory projects but as of yet no real success stories in terms of participatory institutions.

2. National and Local NGOs

(69) The same focus on community and micro level production issues has increased the emphasis and interest in local and national community organizations. Because of the increasing awareness that local issues and involvement has to be dealt with, as soon as a successful national or local NGO or PVO is identified by the international development community, they have been quickly involved in the implementation of project activities.

(70) Methods of involvement have been faulty as local organizations have often been asked to implement projects that they were not

equipped to handle. According to Yacoob, "frequently resources invested in them are far beyond what they can administer, and lead eventually to the group's total disintegration" (1986:14).

(71) Often, their substantial human resource talent has been used for the implementation of a donor sponsored project and therefore depleted by the same supporting international organization that is supposedly building their "local capacity". This is partially because building local capacity has too often been interpreted as giving specific leaders within an organization better financial and management skills which then allows the donor agency to more easily cooperate with the indigenous NGO in the implementation of donor planned projects.

(72) But it is not only in the area of financial and management skills that the local organizations need training. Perhaps the most important area is assistance that will allow local and national NGO's to say, "no, you can't do it like that" to donor organizations. To do this they need to be able to articulate the implications of the participatory processes they use in terms of resources, staffing, timing, and levels of control they need to effectively operate. Because local or national NGOs initial successful endeavors were usually not undertaken under the auspices of bureaucratic organizations, they usually haven't undertaken this analysis.

(73) For example, a national NGO in Kenya, Kenya Water for Health (KWAHO) has had considerable success working with rural communities, especially women, as they try to improve their water supply. A number of international organizations are now interested in using KWAHO to help implement donor funded water projects. SIDA was one of these organizations, and suggested that KWAHO be involved in the role of training and evaluation of the community involvement efforts. KWAHO agreed because they wanted to be involved in the project, but they were reluctant about the terms, even though they could not identify specifically what was wrong with them. Now, almost a year into the Project

they understand that, unwittingly on both sides, SIDA and KWAHO agreed to terms of work that effectively does not allow KWAHO to use their specific participatory process. New arrangements must be re-negotiated—a difficult process under traditional project auspices— if KWAHO is to be successful. The only way to avoid or correct this problem is to initiate effective joint capacity building that builds the strengths for a real partnership relationship. UNDP Regional Projects has recently agreed to fund such an organizational development project with KWAHO.

(74) In the final analysis, local and national NGOs are the best long-term resource for sustainable development at the local level, but methods of involvement and capacity of these national and local NGO's have been faulty because the international donor agencies have too often focused exclusively on the implementation needs of their own projects and not the local capacity building needs of the local organization in terms of their long-term objectives. In addition, international organizations have done little, whether they be PVO's or donor agencies, to look at the new needed capacities that their own organizations must learn in order to become effective supporters of indigenous NGOs and PVOs.

D. Case Histories From the Field.

(75) If international and national PVO's and NGO's are not going to provide the "easy fix" that was originally hoped for, a review of how organizations actually work in the field may provide some interesting insights into actual policy and operational changes that would make a difference. In this section five case histories are presented. They include: the Senegal Government and World Bank Agricultural Resettlement Project; an international PVO Riverbed Farming Project in West Africa; a Freres des Hommes Farm Production Project in

Burkina Faso; the Naam Cooperatives of Burkina Faso; and the Kenya Freedom From Hunger Council.

1. The World Bank Agricultural Resettlement Project in Senegal.

(76) The World Bank financed a ten year resettlement project in the eastern region of Senegal to resettle farmers from land-poor areas to the project area, where the soil is fertile. The farmers were to be taught intensive farming methods which included the use of new technology, draught animals, improved seed, and the application of new methods of sowing, weeding, and harvesting. The project provided credit for agricultural equipment, livestock, and improved seed. Settlers received plots of mechanically cleared land. Despite their efforts, project designers and local officials were only partially successful in obtaining satisfactory levels of participation in the project. Some of the reasons are briefly discussed below.

(77) A major weakness of the project was World Bank planned dependence on the government for definition of agricultural needs and goals and for implementing the project. The Government was expected to provide all tools, seed, training, administration of credit, and creation of the structures through which credit and training were to be delivered.

(78) From the inception of the project it was unclear whether the needs defined by the government - for example, increased cash crop production - were the same as those identified by the farmers. The government endorsed the high technology intensive farming project, designed to increase the production of cash crops. It required high levels of investment, and therefore indebtedness, on the part of the farmer. The farmers were to repay their loans through the sale of cash crops. Yet, as the project evolved, it became increasingly clear that farmers were more concerned about their subsistence food crops.

(79) Another major problem was women's access to land. Here again little had been done by way of application of the principles of traditional social relations of production to project design. Although cleared land had been given to male heads of households, no land had been cleared specifically for women. Project officials assumed that they simply had to supply land to the head of household and in so doing everyone's needs would be satisfied. Women, however, are financially independent of their husbands, and they expect to have their land needs met independently. The married women organized themselves, demanded land, and threatened to leave the project area en masse if they did not receive their allotments of mechanically cleared land. Their demands were met. These initial problems met by the women of the Project, were indicative of other problems that develop throughout the implementation of the project, that were based upon inadequate understanding of Senegalese women's roles in agricultural production.

(80) Partly because they were ill trained and partly because it was easy for farmers to hire labourers during the farming season, farmers abandoned many of the farming intensive techniques advocated by the project. Instead they enlarged their farms and hired labourers during the farming season. This form of seasonal labour is easily available during the rainy season when many young men seek employment in farms in exchange for room and board and a plot of land in which to grow peanuts. Project farmers could thus increase their production in a much cheaper manner than that proposed by the project. Land and labour were abundant in the project area. Unfortunately this method of increasing production has begun to take its toll on the environment. The forested areas that help to stop soil erosion are being cleared at an alarming rate. As a result, farmers are observing the decline in productivity of the soil.

(81) In summary, the resettlement program required a relatively high level of investment in agricultural tools and long term training in the use of these tools. The participants were organized in ways that were perhaps convenient for the government but not necessarily so for the participants. The strategy, even at optimum efficiency, fostered great dependence of farmers on the government, which was unable to meet its obligations to them. Farmers, unable to use much of the farming equipment in their possession, sold some and relied on other means of increasing their output while diversifying their agricultural production.

2. Lessons Learned

(82) The project relied heavily on the government to supply inputs and to provide training for the farmers. However, the government simply did not have the material means to follow through on its commitments. Farmers were inadequately trained and the government was unable to provide the necessary inputs at the appropriate time in the agricultural cycle. This proved to be a major deterrent to the application of farming intensive methods.

(83) Women received no training in advanced farming techniques, neither did they have access to credit except in rare cases when they qualified as heads of households. This diminished possible production success.

(84) Both the government and the funding agency failed to include indigenous resource, expertise, goals and methods in the formulation, design and execution of the project. Thus, sustainable farmer participation proved to be an unrealistic goal.

(85) Even if the project were successful, needs would not have been met on a long term basis. Efforts of farmers to increase production have resulted in serious strains on the ecology in terms of forest depletion, sub-

sequent soil erosion, and resulting decreased productivity, and a decline in real income.

3. International PVO Irrigated Perimeters Project.

(86) The objective of the project was to build irrigated parcels for off-farming season garden plots. A fundamental constraint to participation was that the need for the project was not defined locally. The idea of the project was presented by project officials to the target population as a means of increasing their income. The participants were to produce varieties of food that they did not consume for a market with which they were unfamiliar. They had to learn new methods of farming and had to use special inputs to protect the new crops from parasites. Fertilizers had to be purchased. The additional cost of all these inputs were to be eventually absorbed by the profits.

(87) Project implementation was a top-down process. Project personnel chose the participants and farm plots were then also allotted to the villagers by the project personnel. Women were given no plots to cultivate, because they did not participate in building the parcels themselves. This caused much friction in the community, and many believed that the distribution was unfair.

(88) Though some farmers produced much in the beginning, they did not control the distribution of their produce, and often found themselves with an unwanted surplus of garden products which were not usually consumed locally. Participants were paid with imported foods (which was then sold by the recipients). It was unclear whether participants were motivated because they perceived the project as fulfilling a real need, or whether they were motivated by the prospect of receiving a source of cash.

4. Lessons Learned

(89) This project illustrates the complexity of the factors involved in eliciting real participation when the definition of participation is measured in terms of how many people contributed labor and how many people decided to take part in project activities. Project leaders, because of their initial success at this level of community involvement were describing the project as successful with much "local participation". After the first year with no effective exchange of information, or possible new techniques, the project quietly fell apart.

5. Freres des Hommes in Burkina Faso.

(90) Freres des Hommes (FDH) organization has executed small scale projects in agriculture, health (water use and sanitation) and education in Burkina Faso since 1973. In this particular agricultural project they concentrated on giving improved peanut seeds to those farmers who chose to participate, and supporting this improved technology with access to new tools and techniques. For the new tools that were introduced, FDH financed local reproduction so they would not be creating a dependency on inputs that would be scarce and expensive because they came from outside the country. FDH believed in working on a small scale by presenting technological packages that did not require long-term indebtedness by the farmer, advocated a primary emphasis of cultivation of crops for local consumption rather than cash crops, and providing close follow-up to participating farmers.

(91) FDH has wholeheartedly endorsed the participatory approach; this comes through clearly in how staff describes their organization and the projects for which they are responsible. But as elsewhere, in the final analysis, participation is defined as community people "participating" in a

project conceptualized and designed by the outside agency. Several major problems contributed and resulted.

(92) Because they entered the project with carefully worked out prior solutions, they made no effort to understand traditional systems of dealing with the problems they came to solve. To this end they worked with those that were most likely to succeed—those farmers who were already trying new methods of farming (usually immigrants to the area) and provided them with support in the form of frequent visits for technical instruction, credit, and so forth.

(93) Another problem came as a result of their heavy reliance on government structures to implement their programs. They collaborated with extension agents, school teachers and government organized cooperatives which were not really functioning. They started running into problems when their goals and methods conflicted with the government which was receiving large amounts of aid to invest in agricultural production. Government policy, at the behest of international agency advisors, focused on increasing the production of cash crops on a large scale, creation of government administered granaries, and the extension of new agricultural techniques. Because FDH believed in working on a smaller scale, they soon found that they had trouble reconciling their objectives with those of the Government. At the same time the Government was having difficulty in obtaining even a minimal level of participation from the population.

(94) Another major weakness was FDH's policy towards women's participation in the projects. They had no female volunteers in the field. This in itself was a deterrent to contacting the majority of women in the communities. Their policy was to give improved peanut seeds to those farmers who were already applying modern methods of farming. Yet they furnished these tools and techniques only to men.

(95) Women, who produced 80% of the peanut harvest, were eager to test the new varieties of peanuts and asked volunteers for samples of seeds. Those who had the means would rent the services of farmers with cattle drawn ploughs for preparing and harvesting their own fields. They showed great interest in testing new tools, yet these tools and techniques were not made available to them. Only their husbands, as heads of households, had access to these tools. Those who understood the social relations of production knew that husband and wife had no obligation to one another with respect to their private economic activities. Women were responsible for their individual fields and were economically independent of their husbands. Thus training, credit and materials did not reach them through their households and would have to be provided to them independently of their families.

6. Lessons Learned

(96) In summary, there were a number of positive elements to FDH's program. They were present in the field and tried to define local needs on the basis of field observations. Their method of eliciting participation was non-coercive. Farmers chose whether or not to participate in programs. Only those who requested assistance and who were committed to participate wholeheartedly in the project were incorporated in the program. Their projects are small scale and promote food self-sufficiency and technological self-reliance.

(98) The primary weakness of FDH was their inadequate conceptualization and use of a participatory process that would allow the traditional knowledge and mechanisms of the existing economic systems, with for instance, the independence of men and women's economic activities, to be integrated with new knowledge and production techniques. But this one weakness,

typical of most of the international PVOs, caused an entire program to be short circuited and fall well short of its goals and objectives.

7. The Naam Cooperatives in Burkina Faso.

(99) The Naam cooperatives are traditional village organizations composed of groups of Burkinabe men and women of various ages. Traditionally they have participated in collective activities on the village level, including helping members in their fields, and contributing work to the village chief's fields, where in turn, in times of famine, the chief would distribute the grain harvested in his fields to the members.

(100) The groups have now adapted their activities to the needs of the present, and have formed a "Naam Federation" representing over 1000 of these local groups. They are concerned with maintaining ground water levels, fighting soil erosion, conserving wood through reforestation and more rational use of woodlands, and increasing soil fertility. They themselves have defined the problems and the solutions that are appropriate and have applied for aid in the areas in which they lacked expertise.

(101) They asked for aid only after they had already accomplished a number of steps in the projects. In fact, outside aid has played a secondary role in all their activities. Their development ideology is based on who they are, their skills, their needs, and their specific social context. The federation of Naam cooperatives has already refused aid that they believed would render them too dependent either economically or in development ideology.

(101) The cooperatives have requested technical training in reforestation, gardening, building small dams, and improved metal working among other things. They have also requested technical assistance in projects which require high level technical skills to supplement local technical skills. The Naam confederation keeps in touch with other types of farmer organizations in

order to exchange information and to lend moral and technical support to each other. Thus they widen the base of resources locally available.

(102) They have developed excellent methods of informing and educating members of their communities. They daily apply the principles of soil conservation, reforestation and so forth, and regularly define and implement village scale projects in protecting local forests, reforestation, dam construction, promoting mixed agriculture and animal husbandry, and so forth.

(103) These groups have mastered the essential elements of successful intervention on a small scale. First, they are based on traditional structure and therefore are able to preserve necessary elements of social cohesiveness. They are self-reliant primarily utilizing local human and ecological resources, with congruent technological tools and knowledge that increase production and /or conserve resources. Most important, they have learned, through the intervention of learning processes brought to the group by both inside and outside change agents, how to define their own needs, and as such, are motivated participants in new endeavors. The outside training was mainly performed by a national NGO, who offers community courses, given in the village themselves, assisting the people to identify local problems and local resources.

8. Lessons Learned

(104) The Naam cooperatives have been successful on a small scale. Their successes have partially been circumscribed by the efforts they had to put in to not being "taken over" by outside donors and money, no matter how well meaning the agencies themselves have been. If they could find outside funding groups that would be willing to work within a viable partnership strategy framework, they could most likely extend their successes. Until they

can find such a partner however, they have chosen to stay small in order to guarantee local control and resulting success.

9. Freedom From Hunger Council: Kenya.

(105) Recently in Kenya, a national NGO, Kenya Freedom From Hunger Council, negotiated new agreements with its bi-lateral aid collaborator, German Agro-Action, that attempted to mitigate the negative effects of food aid while building on the positive aspects.

(106) Food aid is a difficult and volatile issue. In times of real drought and emergency, food aid serves human needs and saves lives. In this Project food aid was a necessity for a short amount of time in 1985. However, the problem with food aid is that once its arranged for, it keeps coming even if its no longer needed. In the case of the Council Project, once the initial need was over it became apparent that continued distribution of food would quickly disrupt the fragile balance of the marginal "cash/subsistence" economies that existed in the Project area. On the other hand, there were obviously some households who needed continued help.

(107) The Kenya Freedom From Hunger Council decided to describe and analyze these marginal "cash/subsistence" economies that existed in their Project area and are so typical of most parts of rural Africa. Their analysis illustrated that the traditional decision making mechanism for distribution of communal goods to those in need still existed, and they therefore decided to incorporate that Committee as decision maker for future distribution of food aid.

(108) The result after one year in operation at the Project level, according to the KFHC, is a balance of food security for the most marginal households of the community, and increasing seasonal production for the community as a whole. The KFHC is now building on this positive situation

by increasing local capacity through leadership and agricultural training for both women and men.

(109) The result at the bi-lateral aid level is that grain allotments to the Project were decreased by over 50%, not a desirable outcome from Germany's marketing point of view certainly. However, this small, but effective shift from agency control to local control is indicative of the types of solutions that are needed to solve the complex mix of inter-dependent issues that Africa and concerned organizations are faced with. It also describes the type of partnership oriented research focus that these effective solutions will be dependent upon.

10. Lessons Learned

- Identification and utilization of traditional distribution points allowed a community to remain independent and at the same time build its resources
- Cooperation by the bi-lateral agency in terms of reduction of food aid was a necessary if difficult step on the part of the donor.

E. Who Can Do It?

(110) The first key element of success for creating and developing participatory institutions is the willingness by project leaders, of both local and international organizations, to conceptualize and use the "participatory process" at the community or Project level, which allows local people to become substantively involved in decisions that affect their communities and households. A general focus on "grassroots development" is not enough, nor is rhetorical commitment to participatory development sufficient. What is at minimum necessary, for true partnership strategies to evolve, is a constant and evolving focus on local management systems, two-way information process, and necessary points of local control.

(111) The second key element of success for creating and developing participatory institutions is the willingness by organizational directors and staff at national and international levels to fully accept the need for the process at the local level. Rhetorical acceptance, of which there is a great deal now, is no longer adequate. Rather, national and international development agencies need to begin an analysis of present organizational procedures in terms of their impact on participation programming and management, so that new procedures, congruent and supportive of the process at the local level can be quickly developed.

(112) If these elements for success are going to be effectively initiated certain types of institutions would focus on specific types of roles. A typology of ideal institutional roles is briefly outlined below.

(113)—Local and National NGOs are a crucial intermediary between the local people and outside agencies, both governmental or international. They are an extremely vulnerable and fragile resource however, which can easily be destroyed if they are treated as implementors of outside planned projects rather than as a controlling partner whose local knowledge must often take precedence. Capacity building in community problem analysis, assessment of participatory processes, and analysis of western organizational behavior, as well as finance, and management, will allow them to expand and grow.

(114)—International NGO's who are skilled at working at the local and grassroots levels will be required as linkages and liaisons for outside knowledge, support, and resources to local and national NGOs and PVOs. International PVOs, because of their traditional focus on grassroots development are prime candidates to assist the development process at this local level. For instance, Korten has advocated a "third generation" effort, where international PVO expertise would be used as a link between local NGOs working in a specific community and the funding development organization at the country and international level.

(115) However, other organizations such as institutes, universities, consulting firms, and donor agencies themselves such as UNICEF, should not necessarily be ruled out if they have developed sufficient and substantive expertise in necessary participatory processes. They often can provide people with more experience or expertise in a certain area that may be needed in specific programs. A key point for these types of institutions to be effective is their ability to be involved with programs over the long term, which if they are dependent upon the present short-term donor contracts is not possible. In any case, increased analysis of, and training in, participatory processes for all organizations is crucial to their success at the local level.

(116)—National Governments can create special departments to focus on local involvement, and/or they can choose to cooperate with the local and national NGOs. It should be recognized that government agencies are rarely good "change agents", because of the inherent conflicts between the national and local perspective that is involved in that role for them. International donor agencies have paid far too little attention to this conflict and too often assumed that the national government had the automatic ability to both adequately represent and service the needs of local communities represent as described in the first case history. Traditional government agencies can provide necessary services, but can rarely promote change. Thus for instance, government extension workers are much better at supporting an already achieved agricultural change than creating that change themselves. This support role is extremely important, and donor agencies should not expect that both roles can be played by the same institution, even if their rhetoric claims it to be possible..

(117)—International Organizations at the country mission level have split level obligations. They must begin to institutionalize new operational procedures within their own organizations that support participatory processes at the local level, and at the same time assist the government in establishing new processes of information sharing and research. This is necessary in order to allow local level knowledge to be paired with outside knowledge so that new breakthroughs in African production technologies can take place.

(118) This will not be easy because these organizations often suffer from "isolationism" because they focus on donor inputs rather than country inputs. Inclusion of national professionals as collaborators rather than support staff is a necessary first step, but will take changes in the normal bureaucratic scheduling and operational procedures.

F. Summary

(119) Many readers will be asking "Where are the success stories?, surely they exist! Yes, they do exist. But they exist because leaders of such projects and programs are willing through dint of long hard work and perseverance to overcome the existing operational procedures of an organization and make a project work with the local people. However, that is not a replicable situation. What is discussed in this chapter is the possible use of a participatory process that is replicable, and therefore usable by organizations on a much wider scope than previously possible when participatory processes were solely dependent upon leadership and personalities. This type of organizational focus, if adopted, could break through the rhetoric of "sustainability" and "capacity building" and offer the resources and the method that is so badly needed to achieve these goals.

V. POLICY APPROACHES TO INSTITUTIONALIZING THE PARTICIPATORY APPROACH

A. Crisis Demands Change

(120) Within the development world there is now a strong concensus that the crisis in Africa, and the crisis for development institutions themselves, is directly related to our organizational inability to make good on the rhetorical promises of partnership and local involvement.

(121) What this means is that although we have recognized the necessity of the participatory process for the success of longterm sustainable development, we have not created within our institutions the necessary participatory approaches and procedures that can sustain and support, either directly or indirectly, the central field focus of participation and development. However, the food and hunger crisis in Africa has forced a realization that development institutions must be refocused and refurbished to support "inside-outside" participatory linkages.

(122) What we must accomplish through policy, organizational, and project change is to ensure that the central focus for every development organization whether national, local, or international is the participatory process at the local level. As discussed earlier, this does not mean that all institutions should become grassroots organizations--that would be inefficient and ineffective. What it does mean is that institutions must initiate organizational and operational changes and to focus and support the fact that local control is a necessary and positive part of sustainable projects.

(123) These changes will be difficult and stressful for development institutions to accomplish because division and change of power is always the most difficult of tasks. However, crisis as a syndrome or state does make

change easier to accomplish and the organizational and procedural changes necessary to effect power sharing for sustainable projects have been avoided too long and must now be addressed.

B. Consensus Building at the Policy Level

(124) The consensus that exists however, within development institutions professionals is not as strong at the senior executive level and the policy level because they are further removed from the field of action, so to speak, and the policies needed to create participatory institutions are so inter-dependent with other policy and organizational issues that it is difficult to describe it in a two page memo.

(125) Therefore as long as influential members of aid organizations continue to perceive the possibility of achieving the same results with more manageable inputs and policy changes, a focus on creating participatory linkages will be put off. Presently within USAID and the World Bank there is a strong emphasis on monetary pricing policy as the solution to agricultural development, which if it would work all on its own, as people expect it to, would certainly be easier than attempting to create participatory institutions.

(126) Within Africa, there have only been a very few countries, such as Malawi or Ghana that have seemed to prosper using only inputs of pricing incentives and increased agricultural extension services, but it has been enough to prop up the traditional "input project perspective". In light of recent research however, these props may very well be disintegrating. Therefore, in the interests of building as large a base as possible for consensus building at the policy level it is worth our time to examine the latest developments in the effects of these strongly advocated policies.

1. Malawi: Success or Failure?

(127) Recently documented events in Malawi offer disturbing but helpful insights into the input or process quandary surrounding the African food crisis. The prevailing international viewpoint has been that Malawi is a developmental success story based upon its agricultural production achievements. These achievements were most recently cited by Peter McPherson, Administrator of AID as he addressed the U.N. Special Session on Africa, May, 1986.

> (128) "The results of policy changes are already being felt. Dramatic increases in food production have occurred in a number of countries as the result of the increased prices paid to farmers and the greater reliance on the free market. For example, in Malawi, an 85% increase in maize prices to farmers resulted in over 200% increase in marketed output." (McPherson speech,p.1)

(129) At first glance, the achievements referred to here are indeed impressive. Through a development focus of promoting food export crops, Malawi in 1983 exported about 200,000 tons of maize to Mozambique, Zambia, Tanzania, Zaire, and Ghana, and these export figures were even higher in 1984. These achievements have been highly praised by such international organizations as FAO and the World Bank.

(130) Despite this agricultural production success, recently published reports now indicate that Malawi is faced with some of the most grim infant mortality and malnutrition figures in Africa (Quinn,1986; Williams, 1986).1 According to these reports, A recent nationally representative nutrition survey (1981) revealed over 50% of Malawi's pre-school children to be

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1. Ken Williams is head of UNICEF's Social Statistics Programme for Eastern and Southern Africa and is also co-director of the Joint UNICEF/Cornell University Nutrtional Surveillance Programme. Victoria Quinn is Regional UNICEF/CNSP Programme Co-ordinator, UNICEF, Eastern and Southern Africa Regional Office, and was seconded from the Cornell Nutritional Surveillance Programme. The views expressed in both papers are the individual views of the authors.

chronically malnourished. Comparative data in Kenya shows 37% of pre-school children to be malnourished, and 28% in Zimbabwe. Only in drought torn Ethiopia are comparable staggering rates of child malnutrition found. A major contributing factor is "inadequate food availability and consumption at the household level".

(131) According to Quinn,large donors such as the World Bank have begun to express their concern over the situation, particularly in light of the agricultural strategies and the broad based agricultural extension programmes they are funding, which are in areas showing high mortality and malnutrition.

(132) Reports have recognized that no simple answer exists to the problem, but is rather a complex interaction of a number of social, economic, and agricultural factors. According to results from a Workshop which brought together representatives from the ministries of agriculture, health, statistics and university researchers they include:

—agricultural policies
—commercialization of food crops
—land tenure problems
—constraints on mother's time
—infections and disease
—food habits and taboos

(133) The issues of agricultural production and household food security intertwined with the goals and strategies of low-resource farmers is a complex one, especially in the way these goals and strategies are linked to the larger economic goals of their communities and of their governments, as the Malawi description amply indicates. From this experience, it would seem that the food crisis in Africa does not succumb to forthright linear solutions, and the more complex answers that must be sought require participatory processes that link and integrate needed information and actions from all levels.

2. Linear Solutions Don't Work

(134) The traditional "project input perspective" has at varying times utilized varying types of linear analysis and approaches to the crisis in food production such as a focus on pricing or a particular technology package. In the African food crisis, each of these problems may play a role but none of the solutions are sufficient to solve the problem.

(135) The incapacity for linear planning and focused projects to achieve their longterm objectives is emphasized by the recent forthcoming report entitled Women in Development: AID's Experience 1973 - 1985. In a quantitative analysis of 104 projects from a variety of sectors, the major conclusion was: Projects which recognize gender differences, adapt delivery systems accordingly and ensure substantial female participation are more efficient and more likely to achieve their socio-economic goals. This holds true for mainstream direct service projects in all five sectors—Agriculture, Education, Employment/Income Generation, Energy/Natural Resource Conservation and Water Supply/Sanitation (USAID: 1987:14). An example of the type of subject that linear type programs leave out and gender sensitive participations projects address is crops production in terms of women's land rights._

(136) For instance, little attention has been given to the fact that women are fast losing the small but concrete hold they had on land access rights within the traditional systems. Within these systems, women have either owned their own fields, or have had use rights to fields to the fields that were allocated to her husband by the community or extended family.

(137) But the cash crop economy is fast destroying the old distribution of land by putting it under private ownership, usually in the name of the male head of household. These new systems of ownership do not recognize women's traditional use rights, or if she does acquire land rights it is often for the more marginal agricultural lands. At the same time, the traditional

responsibilities to feed the family still rest primarily with the women of the household, while the men provide the cash for clothes, school fees, and other living expenditures. Both men and women find themselves in increasingly untenable positions as they become more dependent upon an outside market which, because it undervalues their production forces them to produce cash crops in greater quantities, often at the expense of food crops.

(138) This is not to say that women's roles in agricultural production have not been acknowledged—they have. But very little is understood about the flow, distribution, and control of resources and cash within the household and extended family production systems, and how that relates national agricultural policy. This point is certainly well illustrated by the situation Malawi finds itself in, and suggests that the inter-dependencies of these problems focusing on gender sensitive participation should receive priority attention.

C. Conclusion: Multi-Dimensional Solutions Needed

(139) It is the conclusion of this paper that Africa's agricultural production problems will not yield to linear policy prescriptions. The problems that have been identified as directly affecting Africa's ability to feed itself are multi-dimensional problems—agricultural extension programs and cmonetarist policies seemingly solve the agricultural production deficit, and up pops nutritional child mortality and morbidity problems, exacerbated by the very solutions that solved the last problem—and therefore demand multi-dimensional solutions.

(140) The dimensions of the problem, including roles of women in food production, balance of household food security and need for cash crops, impact of food aid on local agricultural production economies, the fragility of the African natural resource base, household economies and extended family

production systems, and integration of agricultural and pastoral production systems, are all inter-active, and their definition as problem or possible resource is dependent upon whether we try to solve them one at a time in a linear fashion as problems, or whether we attempt to utilize them in a multi-dimensional fashion as slender but viable resources of African production systems.

1. New Organizational Focus.

(141) The only way to solve these multi-dimensional problems is to define and establish participatory institutions that can actually "make good" on the rhetorical promises of partnership strategies. The key focus of these participatory institutions must be development and institutionalization of a process that allows local "inside" information to interact with national and international "outside" information, with resulting sectoral decisions on how to immediately improve the existing production system left in the hands of the local people. This interaction of local and international knowledge, controlled at the local level by the local people, will lead to the critical mass of knowledge needed to solve Africa's food production problems.

(142) A process that accomplishes this inter-action, referred to as the "local management participatory process" (LMPP) has been described and discussed in this paper. The LMPP focuses on three elements—local management systems, two-way information strategies, and establishment of local control—that are necessary for the successful implementation of every successful participatory endeavor, but are not culture specific.

(143) This participatory process, because it is not culture specific, and because it utilizes three specific and definable factors, would allow organizations to use it as a replicable process. In other words, the three conditions enumerated above have specific implications for project manage-

ment at the field, country mission, and headquarters level. The implications of these conditions, solidly defined, would give a certain consistency or predictability to the management process that does not exist now for participatory projects.

(144) The LMPP replicability removes the major obstacle that organizations have always had when attempting to work with participation strategies. In addition, the LMPP,in time, may also offer substantive increases and success with local capacity building, the superficial nature of which has been previously noted.

(145) Utilization of this LMPP will necessitate new organizational operations and procedures. At first glance, it may be tempting to ask only project level staff to begin implementation of this new process. However, this will not be sufficient. The implications of this "local management—participatory process" will be felt at every level, and provisions for change at each one of these levels should be provided for.

D. Recommendations: Changes Needed.

(146) If participatory institutions and partnership strategies to increase food production in Africa are going to emerge and survive, initial endeavors to initiate necessary policy and organizational change should begin now.

(147) 1. Congress should mandate a division in aid endeavors and "de-politicize" all aid that is focused on increasing productivity and capacity in Agriculture, Employment/Income Generation, Energy/Natural Resource Conservation and Water Supply Sanitation.

(148) This aid should be made available to all African countries for program periods of not less than ten years. This would not necessarily increase monies allocated, but just stretch the resources available over longer

and more manageable amounts of time from the participatory process point of view. The Senegal River Case History illustrates that "top-down," "resource rich," "short-term" projects cannot work.

(149) For this mandate to achieve its goals USAID should differentiate its Personnel policies. AID employees who are willing to learn local languages, be posted to a country for a minimum of five years, and learn to implement participatory processes should be accorded higher levels of Foreign Service rating and quicker access to senior policy positions. Canada's CIDA should be looked to as a possible model. "Depoliticization" itself is necessary to create the climate necessary for partnership strategies to evolve.

(150) 2. Congress should mandate that primary focus of USAID programs and projects in food production systems will focus on low-input or regenerative agriculture, and that at least 50% of USAID Science and Technology budget be allocated to a participatory technology transfer process.

(151) A necessary corollary of all of the case histories is that new technologies, if they are to be sustainable, must be built upon existing patterns of production and then improved. Low input and regenerative agriculture is the most congruent to traditional African practices, but at the same time seems to be offering American farmers that utilize it improving yields, adequate conservation, and increasing profits. This model should be utilized.

(152) Equal emphasis should be put on both "adaptive research" and "participatory transfer". Inadequate emphasis is presently allocated to transfer processes for science and technology in USAID.

(153) 3. Special Funds should be made available to USAID Missions who wish to implement this "depoliticized longterm local involvement programme". These missions should be identified as "Pilot Project Country Programme Missions", and special funds should be allocated immediately for integrated food production programs that are participatory and gender sensitive.

(154) The Pilot Programme approach should focus on creating an institutional and project learning agenda on how to operationalize new procedures that support the local participatory process. Changes in staffing, personnel incentives, timing, and phasing, are just a few of the changes that can be expected.

(155) 4. *Congress should mandate both internal and external reviews of the bi-lateral aid process and how USAID can centrally incorporate the local management participatory process within the organization. Focus of these reviews should include re-organization; staff training; and joint research endeavors with African nations*.

(156) Policy makers need to carefully define the terms of these reviews, specifically in terms of "privatization" and "micro-economic development" that are presently put forth as goals within USAID and World Bank. The discussions of public and private sector roles leaves no doubt that the Administration is advocating a greatly increased private sector because the public sector has become a "government monopoly", and is therefore inefficient because of high administrative and unresponsiveness to citizen preference.

(157) This policy focus within AID seems to assume that "privatization" in and of itself will lead to greater citizen participation. In the African context nothing could be farther from the truth. It needs to be made very clear that the key word here is *monopoly*, and not whether it is private or public sector. Private sector enterprises, without sufficient competition, also become monopolies with all the attendant problems of high costs and unresponsiveness.

(158) For instance, SODECI, the private sector supplier of rural water provision and maintenance activities in the Ivory Coast has been consistently used as an illustration of "private sector success" by the Administration, and until recently, by the World Bank. SODECI is a good example

of a 'private sector monopoly' that has no competition. Recently it declared that its present contractual agreements with the rural communities do not allow it to make adequate profits. Therefore it has effectively discontinued service to a large majority of its rural clients, even though they have already paid their expensive annual maintenance fee.

(159) More analysis is needed to ascertain the size and type of firm that can actually be competitive and therefore meet people's needs and provide services and products to the rural areas. Lack of access to cash economies may limit possibilities to very small undertakings. However, the Adminstration seems to be advocating methods that will turn public sector services, down at the heels as they may be, into private sector monopolies that will offer no services at all. Congress should therefore ascertain method as well as goal and rhetoric.

(160) 5. Critical analysis and specific fine-tuning of existing economic theory in terms of Africa's fragile natural environments and resulting need for diversified and flexible production systems should be provided through a series of re-orientation and analysis seminars.

(161) Ability to re-organize development organizations into participatory institutions that can grapple with the real inter-dependent problems of agricultural and socio-economic production in Africa is very much dependent upon the re-orientation of professional staff, especially economists, within international development organizations.

(162) Policy prescriptions, conditionalities for loans, and resulting funding for projects is primarily influenced by economists at institutions such as World Bank, IMF, and USAID. Yet these same economists, whether they come from the Western world or the Third World, have been trained only in the use of models that have their theoretical roots in Western national economies.

(163) For an increasing number of development professionals the Western models no longer fit the needs of the African production systems. While most international development economists are very much aware that the natural resource environment is in grave danger in Africa and that the traditional economic distribution systems are relevant to the preservation of these natural resources, they have not had the opportunity to explicitly question the relationship between this danger and the short-term and linear economic measures that their organizations promote. Economists, along with colleagues in other professional disciplines, need to confront the disparities that have become increasingly obvious over the past ten drought ridden years in Africa.

D. Summary

(164) There is often a wish, once the key political decisions have been made in Congress about who gets what, and how much, to keep "development programs" outside of politics. However, when it is defined in partnership terms, we begin to see that it is impossible to keep this tidy separation.

> "it is not a non-political, technocratic process as we were prone to treat it in the 1950's and early 60's. It is a highly charged political process in which power, commitment, and leadership are key variables. These are variables with which those of us trained in more technocratic traditions may feel uncomfortable working with, but with which we may have little choice but to come to terms (Ickis,1985).

(165) There are three areas of policy that most African people feel that the U.S. hides from the right hand of development assistance what the left is actually doing. The most germane to the subject of this paper are food aid policies and the juxtaposition of our agricultural goals with our environmental programs. In addition, comparison of military expenditures and

sales with amounts allocated to development assistance are thought to be, by many Africans, indicators of real U.S. commitments.

(166) These larger areas are necessary to acknowledge because perhaps the most unsettling aspect about participatory institutions and programs is that there is no satisfactory mid-level cut-off point —its all or nothing for both sides. Because the U.S. administration has made it clear to African governments that the way they use their power, commitment, and leadership for development is important for longterm access to international resources, so should U.S. policy makers attempt to focus our country's considerable power, commitment, and leadership on substantive rather than rhetorical partnership strategies. All the easy ways have already been tried and they don't work—the only way left is the hard way—to create and build participatory institutions—together.

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FINAL DRAFT

LOW-RESOURCE AGRICULTURE IN AFRICA

Low-Resource Agriculture and African Institutional Development

by

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More than a quarter of a century has elapsed since the heady era of African independence from colonial rule. Creating independent, highly centralized, sovereign states was seen by many as the only way to insure the rapid development of African states out of their dependency on Western polities and economies. With the coming of independence and the building of strong national institutions to overcome the perceived limits of highly fragmented tribal and ethnic divisions, analysts expected African nations to acquire stronger economies and a higher level of self-determination. Now, the feelings of elation have been replaced by a sense of depression. African countries which used to be able to produce sufficient food for their own populations can no longer do so. Political instability and civil war have marred many of the first efforts at self-governance. African countries have grown more and more dependent on one or the other of the superpowers, on Western economies in general, and on the financial support offered by donor agencies.

Growing attention has recently been paid to the potential role of institutions in helping to speed up the development process more generally. Field offices of donor agencies, such as AID, are urged to pay more attention to institutional development in all of their projects. But what institutions are and how to develop them has been left relatively vague. The term "institutional development" means many things to many people. To some it means various efforts to strengthen the bureaucratic capabilities of central governmental agencies. To others, it means giving management training to governmental and parastatal employees. To still others, it means helping the citizens of African countries to develop their own, effective, decision-making arrangements that are closely matched to the problems that they are trying to solve. The latter definition is the working definition of institutional development used in this paper.

In this paper I have been asked to address the question of how a particular approach to the study of institutional development -- the Institutional Analysis and Development (IAD) approach -- is of value in understanding the problems faced by low-resource agriculturalists in Africa and how institutional arrangements may exacerbate or help to remedy these problems. The answer to this question will be in four parts. The first part will present a general framework that can be used to structure the analysis of how sets of institutional arrangements facilitate or impede the problem solving capabilities of low-resource agriculturalists in Africa. If we are to learn from empirical studies of the operational and performance characteristics of institutional arrangements used by low-resource agriculturalists, there must be a mode of analysis which can be used by different scholars in many settings. A framework identifies the relevant set of questions to be asked about empirical experiences and provides an initial method for interpreting and making sense of this experience. Without a common framework, it is extremely difficult to learn much of general use from the experience of low-resource agriculturalists with different types of institutional arrangements. Learning is limited to the insights that particular individuals gain from particular cases and is not available as a general body of learning to be drawn on in many different settings.

The second part of this paper will consist of the use of the framework to present three different cases of how institutional arrangements enhanced or impeded problem solving capabilities of low-resource agriculturalists in Africa. The third part of this paper will compare the three cases. The concluding part of the paper will examine the implications of the mode of analysis used in this paper.

I. A GENERAL FRAMEWORK

Studies of institutional development which focus on the unique aspects of cases provide valuable information about specific cases to particular scholars and those they study. It is difficult, however, to learn anything more general from empirical studies of low-resource agriculturalists without using a common framework to identify a set of key variables and the relationships which are likely to affect the behavior of low-resource agriculturalists and those with whom they interact in a variety of typical situations.

A framework is used as a methodological tool to help an analyst identify what may be problematical in the human efforts under analysis. Instead of casting the problem entirely in the time and place-specific language of the participants in a particular setting, the analyst tries to identify relevant attributes of key conceptual variables so that the commonalities and differences can be identified and analyzed across different cases in varied settings. The identification of relevant attributes of major conceptual variables makes genuine comparative analysis and eventual accumulation of knowledge possible. A useful conceptual framework will evolve over time as analysts find new concepts more powerful in undertaking diagnostic and prescriptive analysis than previously used concepts.

Scholars using the IAD approach have been developing a general framework drawing on a considerable literature in political science, economics, anthropology, game theory and law. (For background papers on this framework, see Kiser and E. Ostrom, 1982; Oakerson, 1984; E. Ostrom, 1986a; 1986b). The framework is used to help an analyst identify the key working parts of typical situations facing the people being studied at three levels of analysis. The three levels of analysis are the operational level, the collective choice level, and the constitutional choice level of analysis. We will discuss the operational level of analysis in some depth before turning to a discussion of the collective choice and constitutional choice levels of analysis.

The Operational Level of Analysis

Outcomes

At the operational level of analysis, the strategic interactions of actors in a typical situation produce outcomes which are obtained in the everyday world. Typical operational level outcomes for low-resource agriculturalists include: (1) the aggregate amount and type of land under cultivation in a region, (2) the average crop yield per hectare and the crop yield for families or other groupings, (3) the relative prices obtained for crops, (4) the average calories available for family sustenance, (5) the average annual family income from all sources and the distribution of family income, (6) the number of years that a family can feed itself from reserves when drought or other environmental disasters occur, (7) the esteem that a family member feels in a community, etc. Outcomes are evaluated by the participants in a situation and by others using such evaluative criteria as fairness, efficiency, and error-correcting capabilities.

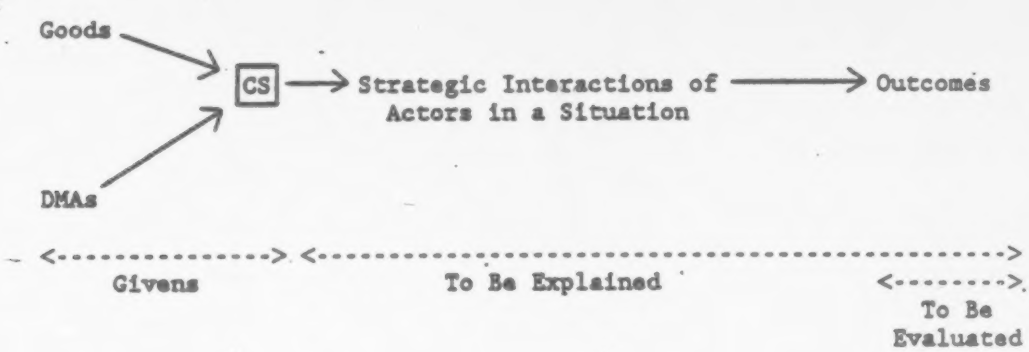
Having identified the outcomes to be explained, the analyst then investigates:

1. The technical/physical/cultural attributes of the goods involved in the problems that participants try to solve;
2. The set of operational decision-making arrangements (DMAs) in use by a set of participants; and
3. The patterns of strategic interactions adopted by participants in a situation.

The relationships among these variables are shown in Figure 1. In an initial analysis of a typical operational level situation, the analyst treats both the attributes of goods and of the DMAs in use as givens. The analyst then attempts to explain both the strategic interactions of participants and the outcomes which result from that interaction. An evaluation can then be made of the outcomes, using a set of evaluative criteria. Space is too limited here to present all of the attributes of each of the broad conceptual fields which may be used in an institutional analysis. I will discuss only a few of the most important attributes for analyses related to low-resource agriculturalists in Africa.

Figure 1

Conceptual Components of Operational Level Situations



Attributes of Goods

Some of the most relevant attributes of the goods being used by participants are:

1. **Exclusion.** When a good is produced or allocated and participants in a situation can be excluded from benefiting from (or being harmed by) that good, the good is said to be characterized by exclusion. On the other hand, exclusion is costly or infeasible when all participants (or a significant subset) are affected by a good whether they have contributed to the effort to obtain the good or not. When exclusion is either physically, legally, or culturally difficult to obtain, quid pro quo relationships are irrelevant in organizing transactions.

2. **Jointness of Use.** When participants use the same facility or resource system simultaneously or sequentially to obtain a good, the good is characterized by joint use. Joint use may be highly subtractive (as when fishermen withdraw fish from the breeding stock of a fishery) or, relatively nonsubtractive (as when low-resource agriculturalists are benefited by a windbreak). When joint use is relatively nonsubtractive and exclusion is difficult, the good is referred to as a public or collective good. When joint use is highly subtractive and exclusion is a problem, the good is referred to as a common-pool resource (CPR) (V. and E. Ostrom, 1978). Examples of CPRs of relevance to low-resource agriculture include grazing from a common grazing area, fishing from a lake or on-shore fishery, and using an irrigation system.

3. Divisibility. When there are units into which it is relatively easy to divide a good or jointly used physical resource system, it is characterized by divisibility. If it is difficult to devise such units of allocation, the good is characterized by indivisibility.

4. Co-production. When a good or service cannot effectively be produced without the active cooperation of several different owners of input resources, the goods are subject to co-production. Education always requires both teachers AND students to engage in a process for students to acquire new skills. Health is another service requiring co-production. Doctors AND patients must exchange information and patients must understand and follow advice given by a health professional before that advice can affect outcomes. The administrative of many development projects is prohibitively costly without the active co-production of participants..

5. Measurement problems. Measurement problems may be involved for any of several reasons. Some states of affairs, such as "peace" and "general welfare," are simple extremely difficult to measure. Analysts are always working with imperfect proxy measures. Measurement problems may also arise when officials and citizens categorize events in a manner which does not give sufficient information about a process they are trying to regulate or affect. Crop statistics, for example, which aggregate too many diverse crops with distinctly different properties may not provide officials or citizens with the relevant information they need for decision making.

6. Risk-reduction attributes. In a western setting, many types of risk can be reduced through the purchase of an insurance policy from a commercial firm. In a Third World setting, many goods are valued not only for their immediate return but also as a hedge against risk. Reducing risk is achieved only with effort. Understanding the behavior of peasant farmers may depend upon recognizing that some goods are primarily risk-reduction goods and only secondarily consumption goods.

7. Degree of choice over consumption. When the mere existence of a good (or bad) forces individuals to consume it, the good is characterized by little choice in consumption. Congested streets, for example, inconvenience all who use them, whether they like it or not. During the Vietnam war, many citizens in the U.S. were forced to live with a policy which they strongly opposed. When it is extremely costly for individuals to avoid consuming particular goods, one can expect higher

levels of conflict than when individuals can exercise substantial choice about whether or not to consume particular goods (V. and E. Ostrom, 1978).

8. Limiting factors. These are the factors in a production process which at a particular time and place are the scarcest or present the toughest constraints on keeping the production process going in an efficient manner. These factors indicate vulnerability to likely bottlenecks or incapacity to produce at all. Limiting factors are frequently quite changeable over time (Commons, 1957).

Decision-Making Arrangements (DMAs)

The second conceptual set of variables of relevance to an institutional analyst in explaining strategies and outcomes is the decision-making arrangement in use by those producing and/or being affected by the outcomes under analysis. Here the analyst attempts to understand who are involved in decision making and the congruence between those producing outcomes and those making decisions about the production processes involved. At the operational level, the analyst needs to obtain information to answer the following questions:

1. Who are the persons participating in the relevant activities?
2. What positions or roles do these participants hold?
3. What actions are participants able or not able to take?
4. What potential outcomes are participants allowed or forbidden from achieving?
5. What are the procedural steps used in this situation and how are the actions of participants aggregated into outcomes?
6. What information is regularly generated?
7. What potential rewards and punishments are assigned to participants at various stages of activity?

The Structure of a Situation

Attributes of goods and of DMAs combine in a configural manner to constitute "the structure of a situation." Because there are many attributes of goods and of DMAS and because these attributes combine in a configural manner, it is not possible to attribute an explanation for observed behavior or outcomes to a single variable. The incentives facing participants result from a complex combination of the attributes of goods and DMAs. In Figure 1, the configurational structure (CS) resulting from both the attributes of goods and of DMAs is separately represented to stress that these variables combine in complex and frequently counterintuitive manners. It is the combination of variables which affects strategic interactions and outcomes.

Strategic Interactions of Participants Within an Action Situation

Here the institutional analyst wants to understand the behavior and strategies of different participants and how they relate to one another. Do participants tend to trust one another and engage in long-term relationships characterized by reciprocity? Are some participants unwilling to abide by the rules that others want them to adopt? Do incentives to shirk or to free-ride dominate other incentives for some participants? Are participants open in providing information to one another or secretive about the intentions, claims, and/or knowledge of past events? Are those making key decisions affecting others interacting on a regular basis with those affected or are they relatively cut-off by geography, status, position, and/or distrust? What types of conflict exist and how are conflicts resolved?

Models of the Individual Used in Explaining Strategies

All analysts implicitly or explicitly use a model of the individual in explaining the patterns of behavior observed in empirical settings. Analysts using neoclassical economics or game theory as their general framework assume that participants have complete information, that they can rank outcomes on some single scale, such as utility, and that decisions are made by individuals so as to maximize the expected utility to be gained (or, minimizing the utility lost) in a situation. This is a useful model of the individual in highly structured settings providing limited alternatives and outcomes which tend to generate accurate information about the situation.

The Fallibilist Model of the Individual

Scholars associated with the IAD approach explicitly use a fallibilist model of the individual. This means that they assume that all individuals are adapting, learning, fallible organisms who seek multiple, and at times, conflicting objectives. Each individual has access to limited knowledge, information, and skills and can make errors in using these. The institutional analyst is faced with the need to try to understand the perceptions and values of those being studied in order to comprehend their rationality rather than impose his or her own model of rationality.

The capacity of humans to learn and to innovate is itself a generator of uncertainty and dynamic change. If innovation proceeds too rapdily, it then becomes difficult for individuals to find sufficient regularity in their environment within which to make stable plans and strategies. This is a tension involved in all human development. Without learning and innovation, human development is nil. But processes which offer the prospect of liberation, by opening up new and more efficient technologies and new ways of ordering human behavior, may challenge the very basis of order and regularity in a society.

This model of the individual leads IAD analysts to generate propositions about the effect of different DMAs as related to the type of goods involved that differ markedly from the conclusions derived from much of modern administrative theory which implicitly relies on a model of an omniscient, and at times, beneficient, individual having ultimate authority to command and control. When one presumes that humans make errors, one is led to stress the need for redundancy. When one presumes that public officials may have interests that differ from those they are presumed to serve, one is led to stress the importance of countervailing powers and multiple arenas.

Using the Framework

The framework helps the analyst identify the attributes of a problem which are likely to influence the results individuals produce in a setting or complex nesting of settings. The analyst will then need to examine the match among the various elements. Are the boundaries for those who are included as decision makers related to a set of goods larger than, or smaller than, the boundaries of the system producing and allocating these goods? If a decision-making arrangement is too large for the relevant goods, many of those making decisions are unaffected by results and have only aggregated information on which to base decisions. If a decision-making arrangement is too small, the actions taken by decision makers are likely to be ineffective. In addition to examining how boundaries match or do not match, the analyst also wants to understand whether the amount, type, and accuracy of information provided to decision makers matches their need for information. Or, whether the incentives facing different participants lead them to act in such a manner that efficient and equitable results are obtained.

What is Explained in an Operational Level Institutional Analysis

The IAD analyst attempts to explain both the strategic behavior of participants and how this behavior aggregates into outcomes. Strategic behavior is explained by using the model of the fallible individual and mentally placing oneself into the position of various participants in order to understand the situation as they view it and to elucidate the positive and negative incentives they face. The analyst tries to explain observed behavior such as: which crops are planted by particular types of participants, which crops are brought to market by whom, who cultivates which pieces of land, where animals are grazed, what violent or surreptitious behavior is undertaken by who, etc. The analyst explains this observed behavior by positing why this behavior is coherent and rational for the individuals doing these activities given the structure of the situation as they experience it.

Having explained the strategic behavior of participants, the analysts proceed to explain how this behavior produces the aggregate patterns of outcomes under analysis. Simply elucidating the motive and incentives of participants is not a sufficient grounds for explaining outcomes, since some situations yield counterintentional outcomes.

What is Evaluated in an Operational Level Institutional Analysis

Having explained strategic behavior and resultant outcomes, an institutional analyst may proceed to evaluate these outcomes using any of a wide variety of evaluative criteria such as:

1. Short-run productivity gains: Has the agricultural (or other) yield obtained from an area increased during the time of a study?
2. Long-run productivity effects: Are current patterns of use likely to enable producers to continue to produce the same or higher yields, or are current practices likely to lead reduced long-term yields?
3. Efficiency: What is the relationship between the input resources used and the outcomes obtained?
4. Fairness: Are outcomes distributed in what is considered a fair manner according to the participants themselves and/or according to other standards of fairness?
5. Error correcting capacities: Is adequate information generated to enable public officials and low-resource agriculturalists to learn about problems early and to take appropriate remedial actions? If participants in one DMA fail to take remedial actions, are participants in any other DMA likely to act?
6. Reproduceability of a structure over time: Do the participants in a typical situation or process understand how it is constructed (in particular, understand the underlying rules-in-use) so that they will teach new participants (children and in-migrants, for example) how to reproduce the structure over time? Do participants face incentives which lead them to try to undermine the structure if they can?

How to Study Change

When the focus of analysis is an operational level situation, the first task is to understand and explain why the outcomes of interest are being produced given the attributes of the goods and DMAs involved. If one is interested in how the structure of situations changes over time, the analyst then proceeds to examine how the structure of the situation changes over time. Change can occur from within a situation or from without. Let us briefly examine both types of change.

Change from Within a Situation

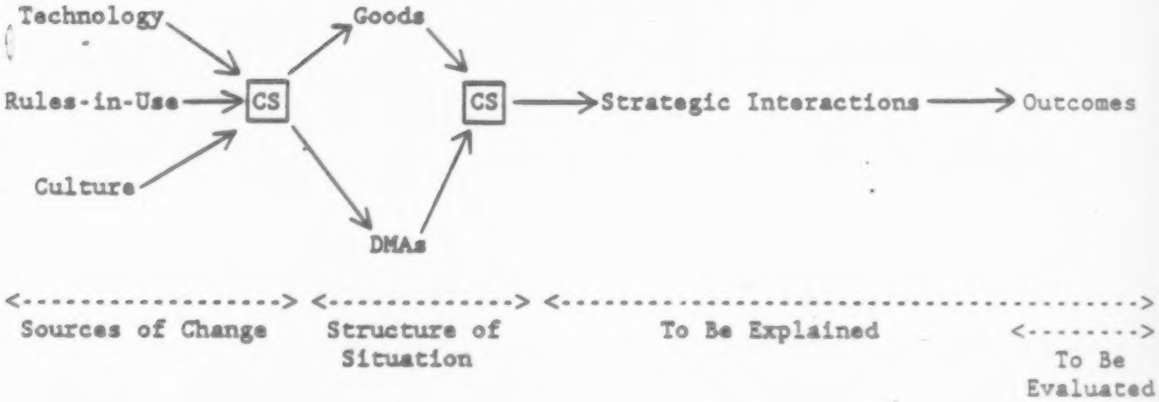
Change from within a situation occurs when internal variables transform themselves over time. Thus, the number of participants in a typical situation may grow or decrease over time. Strategic behavior which was appropriate when there were a small (or large) number of participants may not be appropriate when the number of participants changes. For example, making only limited use of an "open access" common-pool resource, such as a grazing area, may be a rational strategy when there are only a small number of participants who know each other and each other's behavior well. The same strategy may not be the best for any one person to adopt if the number of users grows substantially. If the number of participants changes rapidly, and no new rules are introduced concerning use of the resource, participants who follow the old "cooperative" strategy may be "taken for a sucker" as newcomers callously overuse a resource. In conducting an institutional analysis, one must be alert to variables which may be changing within the situation which could lead to a different set of strategic interactions and outcomes over time.

Change from Without a Situation

Change from without a situation involves changes in three broad clusters of variables which jointly affect the structure of a situation: technology and the physical world, rules-in-use, and culture. Figure 2 presents a schematic representation of these three factors combining in a configurational structure (CS) to affect both the attributes of goods and of the DMAs involved. Now instead of viewing goods and DMAs as givens, they are viewed as intervening components which are themselves affected by: (1) the technologies available for affecting the physical world and the attributes of a particular physical environment, (2) institutional rules-in-use, and (3) cultural world views and norms.

Figure 2

Factors Affecting the Structure of Operational Level Situations


Technology
Rules-in-Use
Culture
CS
Goods
DMAs
CS
Strategic Interactions
Outcomes
Sources of Change
Structure of Situation
To Be Explained
To Be Evaluated

Technology and the Physical World

Much of the effort of the donor community has focused on how to change the technology used by low-resource agriculturalists so that production processes may become more efficient. Many success stories are attributed to technological interventions. Failures have also occurred when technological changes have been introduced without careful attention to the institutional rules-in-use or the culture of participants. When a change in technology gives some participants, for example, increased capabilities to withdraw use-units from common-pool resources, without corresponding changes in the rules affecting who can use, how much, and when, patterns of overuse can lead to the destruction of the resource system. Such overuse may leave low-resource agriculturalists worse off than they were before the technological intervention.

Culture

The culture of participants, along with technology and rules-in-use, affect the structure and outcomes of typical situations. Culture can be thought of as the general, shared, world view of a set of people about how relationships should be and are ordered in a society. What are the structures of understanding that participants do (or do not) share? What is their image of the world and how one should intervene in that world? Do participants rely on such "explanatory" devices as spirits or congerers to explain events or have they adopted a more mechanistic view of the world?

Culture and institutional rules-in-use are both cognitive variables. Culture can be thought of as a general belief system that affects the structure of many different situations. Rules-in-use affect a more limited set of particular situations. Culture changes as a result of new beliefs being introduced and accepted by members of a society. Change may come about through population migrations, trade among people of different cultures, and the influence of mass media. Culture is not as subject to conscious change as either technology or the rules-in-use, and may at times be quite stable and resistent to change. In this short overview of the IAD approach, the role of culture and technology in affecting the structure of the situation cannot be explored thoroughly. We will turn to a discussion of institutional rules-in-use. The reader should keep in mind that the effect of rules-in-use depends on the physical and technological system and cultural views that are related to the rules-in-use.

Institutional Rules-in-Use

Institutional rules-in-use defining who can participate in which situations, what they can do, and how they will be rewarded or sanctioned, are a third major set of variables affecting the structure of typical situations faced by low-resource agriculturalists in Africa. Institutional rules-in-use are shared cognitive variables about which actions (or states of the world) are required, forbidden, or permitted for whom under what circumstances. Institutional rules-in-use are thus the do's and don'ts that participants use, sometimes implicitly, to order relationships within typical situations. Rules-in-use yield predictability in interpersonal relationships when any one actor knows both what he or she is forbidden, permitted, or required to do and how others are expected to behave in commensurate ways.

Thus, institutional rules are constraints on the structure of typical situations to the extent that participants share a common knowledge of the rules-in-use and consider them to be a legitimate set of rules for ordering relationships. Because rules-in-use depend upon shared knowledge and legitimacy, they must be considered as relatively fragile constraints. Rules-in-use can be changed but are extremely sensitive to how attempted changes are undertaken.

One source of institutional rules-in-use is formal actions taken by the participants themselves, their representatives, or their governors to adopt new rules to cover new situations or to change old rules which are perceived to lead to undesirable outcomes. But formal administrative decisions, legislation, and court decisions are only one source of the institutional rules used in practice. If formal actions by governmental bodies attempt to change rules that have been used by participants for long periods of time and are perceived to be useful in ordering relationships, participants may attempt to use the rules they are familiar with and consider legitimate unless considerable resources are devoted to monitoring activities of many individuals in many different locations and severe punishments are imposed for not following a new set of formal rules. The presumption that it is relatively easy to change the strategic behavior of individuals through the simple manipulation of written laws and regulations has led to many disappointments and failures.

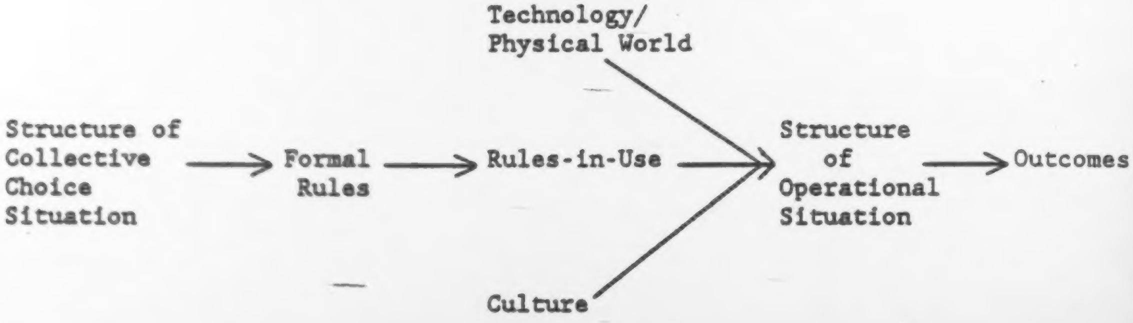
The Collective Choice Level of Analysis

The study of the processes used to change the rules-in-use by participants in typical operational level situations is a different level of institutional analysis. The collective choice level of analysis must be used when analysts want to understand how rules that structure operational situations are changed and who participates in these change processes. In traditional times, collective choice processes were largely evolutionary processes. Participants in typical situations would "discover" new rules by experimenting with various ways of organizing their recurring and typical situations or by learning how others dealt with similar situations. If participants successfully lived under relatively precarious conditions in the same region for a long period of time, one would expect that the rules which eventually were accepted and passed on from one generation to another as a relatively rigid set of rules-in-use were well adapted to the environment in which participants lived.

In recent times, collective choice processes have become more formal and have tried to change the rules-in-use by participants in various situations through self-conscious analysis and formal actions. A schematic representation of how collective choice situations are related to operational choice situations is shown in Figure 3. The outcomes of collective choice processes (particularly in modern times) can be thought of as "formal rules" which are intended to affect the "rules-in-use" affecting the structure of typical operational level situations. To predict the ultimate outcomes of collective choice processes, the IAD analyst must conduct analysis at both the collective choice level and the operational level. A schematic representation of the relationship between collective choice and operational level situations is shown in Figure 3.

Figure 3

The Relationship Between Collective Choice and Operational Level Situations


Technology/
Physical World
Structure of
Collective
Choice
Situation
Formal
Rules
Rules-in-Use
Structure
of
Operational
Situation
Outcomes
Culture

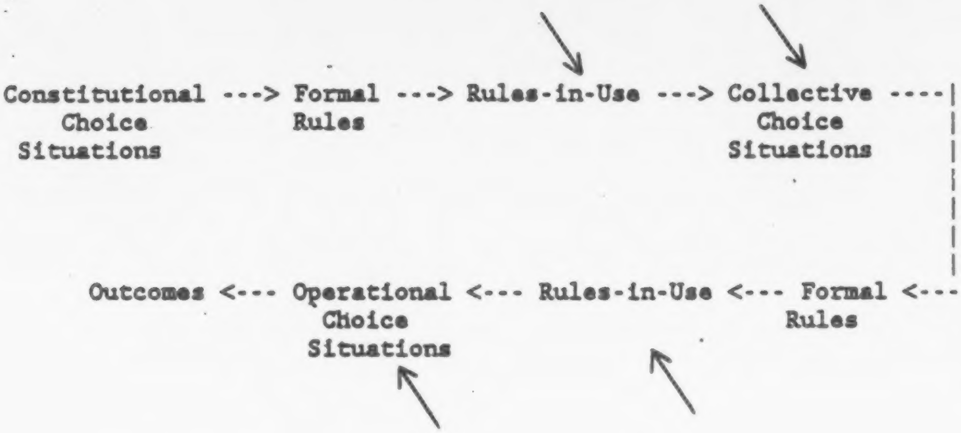
The Constitutional Choice Level of Analysis

One of the conclusions coming from the IAD approach is that when the participants in typical situations are able to engage in collective choice processes themselves (or, are able to select representatives who are intimately familiar with particular types of situations), that the efforts to change formal rules will be more successful. The potential for a higher success rate stems from several reasons: (1) participants in a process are more apt to know the rules-in-use and thus know which rules might be the appropriate ones to change, (2) when participants themselves have engaged in collective choice processes, they are more likely to share an understanding of what rules are being changed and why, and (3) change in the rules adopted by the participants (or their close representatives) will be considered more legitimate than when changes are imposed on participants by distant governors.

This conclusion is the result of analysis conducted at the third level of analysis involved in the IAD approach -- the constitutional choice level of analysis. At this level of analysis, the analyst wants to understand how the constitutional rules that structure collective choice processes affect the type of formal rules adopted at the collective choice level and ultimately the effect of those formal rules on the outcomes of operational situations. There is a long chain of relationships from the constitutional level of analysis to the outcomes obtained in an operational situation including many factors not under the control of those attempting to change the rules-in-use at an operational level. This long chain is illustrated in Figure 4 where the four diagonal arrows represent the many other factors also influencing the set of relationships.

Figure 4

The Multiple Levels of Institutional Analysis


Constitutional Choice Situations
Formal Rules
Rules-in-Use
Collective Choice Situations
Formal Rules
Rules-in-Use
Operational Choice Situations
Outcomes

The Analysis of Rules

The apparent variety of specific rules used by participants in situations is overwhelming and has been a barrier in the past to the cumulation of knowledge about how different combinations of rules affect behavior and outcomes. Scholars in the IAD approach have attempted to develop a method for identifying general classes of rules affecting the structure of situations at all three levels of analysis. When examining the rules-in-use (or, rules being proposed or in formal legislation) the IAD analyst identifies:

1. Boundary rules set the entry, exit, and domain conditions for individual participants.
2. Position rules establish positions, specify procedures by which participants are assigned into positions, and define who has control over tenure in a position.
3. Scope rules specify which outcomes can be affected and set the range within which these can be affected.
4. Authority rules prescribe which positions are authorized to take which sets of actions and how a series of actions are ordered, processed, and terminated.

5. Information rules affect the information individuals have about the structure of the situation by establishing information channels, stating the conditions when they are to be open or closed, creating an official language, and prescribing how evidence is to be processed.

6. Aggregation rules affect control by prescribing the formulae for weighting individual choices and calculating collective choices at different points in a process.

7. Payoff rules prescribe how benefits and costs are to be distributed to participants in positions given their actions and those of others.

To illustrate how these types of rules affect complex action arenas, the types of rules involved in structuring a competitive market are listed in Table 1. The simple statement, "let us assume a highly competitive market," presumes that participants act with reference to a complex set of rules similar to those shown on Table 1.

Table 1

Working Rules of Competitive Markets

BOUNDARY RULES

1. Buyers and sellers may enter and exit at their own initiative.

2. Licensing requirements for sellers or buyers are minimal.

3. Buyers and sellers must own or borrow resources to enter.

4. Exit is forced on sellers if long-run profit is less than zero and on buyers if they do not have sufficient funds to buy.

SCOPE RULES

1. Participants can exchange their own or borrowed resources and goods but not resources owned by others.

2. Participants are limited in terms of costs they can externalize on others -- rules regarding what is an allowable externality vary from market to market.

POSITION RULES

1. Positions of owner, seller, buyer, employer, police, judge, and jury are defined.

AUTHORITY AND PROCEDURE RULES

1. Seller authorized to decide how much to offer for sale at what price.
2. Buyer authorized to decide how much to offer to buy at what price.
3. Police authorized to arrest those suspected of unlawful use of resources and goods owned by others.
4. Judges authorized to determine rights and obligations of buyers and sellers in civil proceedings and of suspects in criminal proceedings.

INFORMATION RULES

1. Prices of current offers to sell and buy are available to all participants.
2. No participant is authorized to force information from other participants concerning preferences or costs.
3. Seller may have to provide specific information on content of goods.

AGGREGATION RULES

1. Whenever any two participants agree to an exchange, that transaction is authorized.
2. Police can make an arrest on their own initiative.
3. Aggregation rules for judges and juries vary depending on type of case.

PAYOFF RULES

1. Seller retains profit, if any, after payment for input variables, taxes, and interest.
2. Buyer retains consumer surplus, if any, after payment for goods.
3. Suspects pay fines, or spend time in jail, if judged guilty of criminal acts.
4. Buyers and/or sellers pay damages and costs to other parties if ordered to do so by judge.

II. SOME ILLUSTRATIVE CASES

At this point several illustrations of institutional analyses may be most useful. Three case studies will be presented. Each of these cases has been described in much greater detail by the case authors in the works cited. In the next three sections, I have greatly shortened the length of each case while trying to retain as much of the text of the original case as I could.

The Nigerien Windbreak Case

Original Case by Thomson (1985)

Background

In 1974, in the Majjia Valley of south-central Niger, West Africa, the Nigerien Forest Service, with financing and counsel from CARE, an American private voluntary organization, launched a windbreak project. The purpose of the project was to develop windbreaks in the valley floor to protect productive farmland from fierce wind erosion. Peasant farmers were initially told the trees would belong to those on whose fields the windbreaks were planted. As the windbreaks spread through the valley over the next decade, the rules changed: peasants were informed that the windbreaks would be planted on their fields, by them, under Forest Service supervision. Protection for the young trees from browsing animals was provided by local guards hired and controlled by the Forest Services, with CARE financing. The trees would be the property of the Forest Service and not the farmers.

By 1984, the total length of the double-row windbreaks exceeded 200 miles. As they matured, they performed their on-site, environmental protection function with increasing effectiveness. Peasants came to appreciate the windbreaks because, by their own evaluation, they increased agricultural productivity. However, two problems arose: (1) CARE wished to terminate its funding of the project to shift efforts elsewhere and (2) the windbreaks were producing wood and other products which could be harvested without disturbing the windbreak.

Attributes of the Good

Windbreak trees cannot easily be categorized as strictly collective, strictly private, or as common-pool resource goods. They embody collective good elements in that the trees, as windbreaks, reduce wind velocity and create a microclimate within the protected area which is more favorable to field and garden agriculture. Anyone benefits, who farms land within the breaks, whether or not trees grow on the land that any given individual cultivates. Cultivating land protected by the windbreaks is a nonconsumptive on-site use of the windbreaks. As long as an external agency pays for the trees, requires their planting, and guards the windbreaks, the public good aspects of this resource are produced.

After the windbreaks are established, they also produce a series of consumable "use-units": timber (if coppiced); building poles (if pollarded); firewood; Acacia scorpiodes seeds, which contain tannin used in treating leather; and browse for goats. Given the high cost of fencing the windbreaks, the production of usable wood products can be thought of as a common-pool resource. Managing this aspect of the resource -- without destroying the windbreaks themselves -- is a more complex set of activities requiring a higher level of common understanding and input by local residents than simply managing the nonconsumptive, public good aspect alone. Managing the consumptive use of forest products was exacerbated in this case because the supply of firewood in the surrounding area had been severly depleted. The value of the supply of firewood contained in the windbreaks increased over time. Without the active co-production of users in a management scheme to regulate the use of the windbreaks to produce wood products, the costs of managing this system could escalate greatly.

Operational Decision-Making Arrangements

Legally, the windbreaks have been treated as owned by the national government. Officials of a national agency -- the Nigerien Forest Service -- decide where trees would be planted and what use patterns are allowed. Foresters have allowed farmers to collect crop residues and feed them to their animals outside protected areas, but movement of herds onto the fields which would threaten the windbreaks is forbidden. Paid guards patrol the windbreaks regularly to enforce the strictures against harvesting.

Patterns of Strategic Interactions

Valley residents have become passive subjects in their relationship to one another and to the Nigerien Forest Service in regard to the windbreaks. Someone else paid for the trees and designed where the trees should be planted. Valley residents then followed orders concerning when and where to plant these trees. Because the trees are guarded, valley residents have primarily viewed the trees as someone else's property and have refrained from surreptitious cutting. Individual farmers have had to slowly sell off their flocks of ruminents because of the difficulties they have faced in keeping these animals away from the windbreaks and because they could not pasture them elsewhere. So long as others do the work, valley residents can take a very passive role in relationship to the windbreak and still receive the public good benefits produced by the windbreak.

Outcomes

Enhanced agricultural productivity has been a major outcome of this project. Valley residents using fields in protected areas have expressed solid satisfaction with the effect of the windbreaks on agricultural output. Residents credit the windbreaks with improving agricultural output in protected fields and reducing wind erosion. Initial evidence suggests that agricultural output may have increased 15-20 percent despite a loss on an average of 15 percent of arable land in the valley bottoms to windbreak lines. The individual family shares of this enhanced outcome vary directly with the amount of land owned after land was exappropriated by the government for use in the windbreak project.

As important as the outcomes which have occurred are the outcomes which have not yet occurred in the form of managed harvesting of diverse wood products from the windbreak. A resource of considerable value to low-resource agriculturalists -- particularly given the growing shortange of firewood -- is being underutilized. If the funds which pay the guards were to be cut off, it is uncertain what will happen to the mangement of this important resource.

Analysis of the Nigerien Windbreak Case

This case illustrates the feasibility of an intervention by external donor agencies working with central governmental agencies to produce one type of local, public good. The public good produced requires little in the way of co-production by local residents in terms of input and management activities. By financing the purchase of the trees, requiring that local farmers plant them in locations designated by the Nigerien Forest Service (a low level of local input which did not have to be sustained over time), and then employing guards to patrol the windbreak, an external donor working closely with the Nigerien Forest Service was able to increase the productivity of low-resource agriculturalist living in the Majjia Valley. Common understanding of the rules-in-use has been accomplished and local residents abide by these rules relatively well. The common understanding is that the Nigerien Forest Service owned the windbreaks and that management and enforcement activities related to the development of the windbreak would be organized and paid for by the Nigerien Forest Service (with help, if they could get it, from CARE).

This case also illustrates a classic problem for external donors and national governments. Once external donors have succeeded in producing local public goods, they want to divert their time and limited resources to other projects. The problem is: How do they leave a successful project without witnessing the destruction of the local public goods they succeeded in producing? What has been produced in a short time by external donors can disappear just as rapidly after the donor agency moves resources to other projects. Further, the case also illustrates the difficulty of developing effective management systems for local, common-pool resource systems when local participants view the resource as being owned by someone else.

As long as a national agency "owns" a common-pool resource, the national agency must determine acceptable use patterns and invest heavily in monitoring mechanisms to insure that these use patterns are adhered to. As long as guards patrol the windbreaks, rules will be followed. But the common view of residents is that any valley woodstock resources not protected effectively by government foresters constitute unregulated common-property resources available on a first come, first serve basis. Given the growing shortage of firewood, it would be more and more difficult to convince valley residents to forebear from harvesting the firewood in a way that destroyed the windbreak itself. Designing, running, and enforcing a management plan involves a national agency in large expenditures to enable a highly localized resource system to be managed effectively over the long run.

Thomson and colleagues were asked by the Nigerien Forest Service and by CARE/Niger what changes in formal rules (and hopefully, in rules-in-use) might enable them to reduce their input substantially (if not entirely), facilitate the development of a long-term harvesting strategy to maximize the amount of consumable forest products that could be harvested from the windbreaks, but also insure that the local public good aspects of the windbreaks were maintained. An additional objective was that the local management system should generate sufficient revenue to sustain itself and eventually provide resources for additional environmental projects in the same valley.

In light of the information summarized above, Thomson prepared several alternative institutional arrangements for CARE and the Nigerien Forest Service to consider. The first general model involved local user group members -- defined primarily as residents of local villages with the possible eventual inclusion of nomadic herders -- as the primary actors in the eventual management system. Thomson envisioned one variant of this model which would involve each village in designing its own local constitution for how it wanted to run the system. A second variant involved the development of one or more standard format constitutions. If several variants were created, villagers could then select among several "boiler-plate constitutions." However the constitutions were developed, Thomson recommended that user groups must be clearly authorized to deal with windbreak issues. The territorial jurisdiction of each user group would need to be clearly defined. Then a series of management rules would need to be developed including:

1. Rules Governing Windbreak Creation. Who may/must work on planting activities, how much work can each be required to furnish, during what time periods, and on what terms?

2. Rules Governing Windbreak Maintenance. Under what terms can various types of livestock graze on crop residues in the windbreak areas?

3. Rules Governing Harvesting and Distribution of Windbreak Products. What harvest procedures are to be used between and during major cuts? Who is authorized, what methods can be used, and how will products be distributed?

4. **Rules Governing Rule Enforcement.** Who within the group is responsible for rule enforcement, how will infractions be punished, and how will disputes related to infractions be resolved?

An alternative model proposed by Thomson involved both local user groups and the Forest Services in the system. User groups continued to be largely village based, but the Forest Service would be accorded a fixed share (say, one fifth) of the major harvest of forest produce. Forest Service representatives would be members of the resource management units in each of the village decision-making bodies. In this model, the constitutions for each user group would be standardized. Votes would be given to each of the member groups -- windbreak field owners, village residents, and foresters -- as a function of the shares in major harvesting of windbreak products accorded each group.

The particular rules to be developed under this system would heavily depend on the part that Forest Service representatives are to play in the windbreak management system. If foresters bear responsibility for technical integrity of the management system, it might be appropriate to assign them veto authority over critical activities. This would, however, have the disadvantage of dampening villager incentives to participate in the management system. Thomson points out that if the foresters were to establish monopoly control over all technical decisions, village participation would remain weak. Most residents would conclude that the foresters still run the game. He urges that if this model were adopted that the foresters' power within the management system be specifically limited. All of the rules outlined above would also need to be outlined in this model.

The most delicate problem to be solved would be how to convince local users to set up user-group-run rule maintenance activities if the foresters continue to play a dominant role in decision making.

Thomson prefers some variant in which the local user group manages the system and the Forest Service plays at most a back-up role. He has provided, however, an alternative institutional model for a shared system in which the power of the national government agency would be severely limited.

Top-Down Planning in Senegal

Original Case by Gellar (1985)

Background

In 1977, Senegal was one of the first Sahelian countries to formulate a comprehensive food investment strategy to attempt to increase domestic grain production, sharply cut grain imports, and move towards food self-sufficiency. For producers, the Food Investment Plan (1977-1985) called for the acceleration of rainfed grain crop programs -- millet, sorghum, and maize -- while maintaining the existing pace for its more costly rice irrigation programs. For consumers, the Plan stressed promoting the consumption of domestic maize, millet, and sorghum through better processing of these products and dampening demand for imported wheat and rice by raising their prices. It was assumed that raising import prices would induce shifts in demand towards domestic products. The Senegalese Food Investment Plan was based on a presumption that increased grain production was essentially a product of state action.

To achieve the Plan's ambitious objectives required more money for state agencies to expand activities. Senegalese officials estimated that a billion dollars over the 1977-1985 period would do the job. Donors were expected to provide most of the investment capital. The Food Investment Plan, which was typical of the top-down approach of the Government of Senegal and of many other African countries, never really got off the ground. Rather than moving towards food self-sufficiency, the situation worsened. Per capita grain production stagnated while grain imports climbed, leading to a new crisis. This crisis precipitated a policy "dialogue" between the Senegalese government and the international donor community.

The Senegalese government agreed to accept many of the policy reforms proposed by the IMF, World Bank, and other western donors. The New Agricultural Policy (NAP), adopted in April 1984, called for drastic cuts in the size of several development agencies, formulated a plan to eliminate state intervention in the distribution of seed and other inputs, and reiterated a commitment to transfer more responsibility to private sector actors. After further pressure, the Senegalese government increased the official price of rice from 130 CFA to 160 CFA per kilo. This decision coincided with pledges by the IMF and Senegal's main donors to reschedule Senegal's foreign debt payments and provide sufficient aid to get Senegal through a difficult period.

A major presumption of this move was that low urban food prices made possible through cheap food imports destroy incentives to farmers to increase grain production. Limiting these disincentives would motivate farmers to work harder to increase their grain output, it was thought. As domestic grain prices became more competitive with imported grains, local grain producers would be able to recapture the domestic market. Gellar predicted that this increase in the official price of rice would, like the earlier policy, not produce the substantial increase in the production of domestic grains that the central planners hoped for. His micro-institutional analysis provides an explanation for the failure of the earlier policy and a prediction that the January 1985 policy will also produce weak results.

Attributes of the Good

Although millet is essentially a private good, i.e., one that is highly divisible and can be packaged, contained, and measured in discrete units, millet has other cultural and economic attributes which dampen the responsiveness of low-resource agriculturalists to market signals. Senegalese national planners tend to classify millet as a private good exchanged primarily in response to market incentives and underestimate the extent of nonmarket incentives underlying the production, consumption, and exchange of millet in rural Senegalese society. Further, millet has been treated as a homogeneous product by central planners. Different varieties of millet and sorghum are lumped together as "millet/sorghum" in aggregate statistics about production trends, productivity per hectare, official prices for millet, and the volume of millet sold through official channels. By treating all millets and sorghums as the "same" good, planners fail to consider how different varieties, quality, and uses of millet would affect peasant production strategies, yields, and real market prices.

The three major types of "millet/sorghum" include: (1) souna (an early ripening bulrush millet which can be harvested in September), (2) sanio (a latter ripening bulrush millet which is harvested -- with higher yields than souna -- in November), and (3) sorghum (which is harvested in March and April and planted in the heavier clay flood recession lands bordering the Senegal River). Souna, sanio, and sorghum are cultivated and rotated with other crops such as cowpeas, beans, and peanuts. While the yields of souna are not as large as those of sanio, low-resource agriculturalists prefer to plant at least some souna because of its early harvest date. Both varieties of millet are used as a subsistence crop and basic staple for most meals as well as being used in many religious festivals, as collateral for loans from local sources, as a source of payment to fulfill religious tithing, and as a source and sign of wealth.

Operational Decision-Making Arrangements

Senegalese Family Structures

In Senegal, rules governing family structures and the different status of individuals within a family are especially important in understanding rural production systems and individual economic strategies. In Senegal, the senior male household head is responsible for managing food grain production which is produced collectively by the family on the family head's plot. Dependents have an obligation to contribute labor, and the male household head has the obligation to provide food to dependents throughout the year. Male household heads generally devote a relatively larger portion of their personal plots to grain crops than dependents do on their personal plots. Dependents would rather put less time and effort into producing food for the household and more time into producing commercial crops or other activities which could provide them with revenues for their own personal use. Considerable tension has erupted in recent times within many Senegalese families over the obligations of dependents to provide labor for family plots as contrasted to pursuing their own individual interests.

Senegalese Official Market Structures

The official price of millet and the formal rules for regulating the official markets for millet for a given year are generally established by presidential decree. The official market for millet and sorghum begins the first week of November. Official prices are set for the producer, the wholesaler, and the retailer. The presidential degree, however, only minimally affects local market operations because the government's uniform pricing system does not take into consideration such factors as seasonal variations in prices, differences in quality among varieties, and the impact of the size of the crop on prices. Souna, for example, is harvested in September. Low-resource agriculturalists do not wait until the official season opens in November to sell their millet. At the time of harvest, farmers -- particularly the poorest farmers -- must sell at prices determined in a local market. When there is a good harvest the local price at the time of the harvest is below the official price. Later in the year, the local price may be higher than the official prices. Only the wealthier farmers who can hold their millet supply until they can obtain the best local price. Thus, operational DMAs vary substantially from what is perceived in the nation's capital because the rules-in-use in local markets are quite different than the formal rules pronounced in various administrative documents.

Outcomes

Let us discuss the outcomes in this case prior to discussing the patterns of interaction. To get a clear picture of the outcomes of this system, one must disaggregate the national production figures. For example, there has been a steady secular decline in souna and sorghum production all along the Senegal River since the 1960s. During the 1960s, the region produced more than 50,000 tons seven out of ten years; during the 1970s, it produced more than 50,000 tons only two out of ten years; and in the 1980s, souna and sorghum production combined have averaged less than 18,000 tons a year. This last decline has had more to do with subnormal rainfall, the low level of the Senegal River, and the expansion of irrigated agriculture and less to do with government pricing policies. On the other hand, if we look at disaggregated data for the peanut basin, both souna and sanio production has been expanding in absolute terms particularly in the older and more densely populated areas. But per capita millet production has gone down. Fallowed fields are disappearing. Without significant investments in organic and chemical fertilizers (or a breakthrough in millet production technology), millet productivity is likely to decline still further.

Patterns of Strategic Interaction

The outcomes discussed above can be "explained" using traditional micro-economic methods. The explanations offered using this method are that: (1) official prices in Senegal as well as in most of West Africa are relevant to only a small proportion of agricultural products actually marketed and (2) "price responsiveness of production for millets and sorgham is very low (as is the case for most African food crops), and that even real (not fictitious official) price increases are a necssary but not sufficient condition for substantial increases in production" (quote from an anonymous referee). This is one form of an "explanation." It tells the observer that there is something going on in the way that farmers respond to price signals; that farmers are not very "price responsive" even to real prices.

This explanation does not, however, tell policy makers why farmers are not price responsive and what problems farmers face to limit their capacity to respond to price incentives. To ascertain why these outcomes are produced, one needs to examine patterns of interactions among participants. For government policies to succeed in increasing the quantity of millet sold in official markets, one needs to increase the proportion of land planted in millet, the proportion of harvested millet solid in official markets, or both.

Similar millet pricing signals have a differential impact on different household members and different regions of the country. The pioneer zones of Senegal Oriental, for example, are cultivated by a larger percentage of unmarried or newly married males who have fewer dependents to support and who are motivated largely by the desire to earn currency through cash crops. But in these areas, cash crops, such as peanuts and cotton, are more remunerative than millet. A sharp decline in the proportion of cultivated land allocated to millet has occurred in these regions over the last two decades.

A further shift to cash crops has not taken place in the "older" peanut basin where land shortages have pushed the younger dependent males to migrate to less sparsely populated lands or to seek work in the towns. Rather than a shift from food to cash crops since the 1960s, one has seen a modest shift towards millet. But in these regions, older males responsible for large households do not sell much millet in the officiall market. Approximately 75 percent of the millet crop is retained by the producers themselves. Some of this millet is consumed during the year, but in good years some might be sold. Given the uncertain climatic conditions in Senegal, many Senegalese peasants prefer to store rather than sell surplus millet in order to provide food security for the future in case of crop failure. Storing millet is like buying insurance against future crop failures. This risk reduction strategy is particularly important to older household heads with extensive family responsibilities in years of poor harvests. Further, of the 25 percent of the millet crop that enters into circulation, only a fraction of that figure is marketed through official channels at official prices. This is especially true in years when crop production is lower than average and real market prices much higher than official ones. Millet producers do not have the option of selling millet at the official prices when they most want to -- at the first harvest in September -- because the official marketing season opens too late and the government agencies charged with purchasing the millet crop usually do not have sufficient cash on hand to purchase all the millet offered at the official price in periods when millet is plentiful.

Analysis of the Senegales Top-Down Planning Case

This case illustrates the importance of doing micro-level institutional analysis when undertaking policy analysis for major macro-economic policies of interest to both donor agencies and national governments. The opportunities and constraints created by the institutional arrangements of family structure and of local unofficial markets affect production decisions more directly than the almost illusionary "official market." Further, aggregating several distinct products under one name for purposes of setting prices, collecting production information, and undertaking major reforms doss not give any participant in the process -- planners or farmers --- adequate information to make informed choices.

The Botswana Land Board Case

Original Case by Wynne (1985)

Background

In 1968, Botswana's central government authorities undertook a major reform of land and water resource institutions which had been in operation since the mid-nineteenth century. The new administrative system of land boards established by the Tribal Land Act was expected to provide more professional resource management and to end discrimination in the allocation of use-rights to resources. Despite thoughtful attention devoted to the design of the land board system, substantial conflict continues to surround the management of land in Botswana. Disregard for the rules by which cultivation land is supposed to be managed has emerged as a persistent and widespread problem. Farmers have cleared and plowed unauthorized fields, illegally extended the boundaries of their existing fields, and altered new boundary markers erected by land board members. Land board members are known to have refused allocation requests in order to protect their own or relatives' interests in undeveloped land.

Two explanations can be advanced for the level of conflict and illegal behavior which has followed this institutional reform. One is that the problems which have arisen result from simply the confusion created by institutional changes among officials and ordinary citizens who do not yet understand the intent or substance of the new rules. Accepting this explanation leads to a policy prescription for more training and public education. Central ministry officials in Botswana tend to accept this view and have allocated substantial funds for additional training. A second explanation is that the new rules have had the unintended result of creating incentives which offer officials and farmers opportunities to act in perverse ways. Acceptance of this second explanation suggests the need for changes in the design of the new institutions in order to restructure the incentives of various participants.

Attributes of the Good

In Botswana, land used for cultivation is held in common. Fertile soil is the natural resource that produces a stream of "cultivation possibilities" which can be realized in the form of crops. Resource consumption is subtractive. One portion of fertile land cannot be simultaneously cultivated by two producers. The difficulty of excluding interested users from the resource system derives from the strength of long-standing community norms which hold that land belongs to all members of a community and that all who wish to cultivate should have rights to a plot of land. Common land used for cultivation purposes is a frequent pattern in low-resource agricultural areas of Africa.

Common land is, however, an unusual common-pool resource in that it requires the partitioning and assignment of consumption rights regardless of the level of demand for the benefit flow. If land used for cultivation is not physically divided into separate plots, producers would have difficulty in appropriating the benefits generated by their work. Land cannot be used for cultivation in the absence of rules which assign rights to the flow of crops from plots to production teams. Poor management of a cultivation commons leads to a reduction in the net value that production teams can derive from the commonly held land instead of the depletion of the resource which is the result of poor management of other types of common-pool resources.

Effective management of a cultivation commons used by low-resource agriculturalists largely depends on the way cultivation is organized and the alternative opportunities available to different participants. In the Letlhakeng village area of this case study, cattle keeping is the preferred economic activity. Herd owners attempt to keep herd growth rates high by selling off young male animals to buy female calves. Cattle are seldom eaten. Due to the uncertainty of rainfall, grain production has never provided a dependable source of food. Since the mid-1920s, men from the area have depended upon employment opportunities in the mines of what is now the Republic of South Africa and in Botswana towns to supplement their grain production activities.

Operational Decision-Making Arrangements

The land boards replaced a land management system in Kweneng that had been in operation since about 1855. For day-to-day management, chiefdom land had been divided among the leaders of the three major sections of the Bakwena. Each section leader distributed authority for large areas to leaders of subordinate makgotla (s. lekgotla, largely kin-based administrative units) within his section and to leaders of Bakgalagadi makgotla who were attached to his section as subject people. Subordinate officials were supposed to carry out the policies of the Bakwena chief and section leaders, but in practice, Bakgalagadi managed land and water resources with considerable independence. Population densities were low and the cost of moving from one settlement of kin to another in central Kweneng was also low. Bakgalagadi authorities were thus considerate of the preferences of others in assigning cultivation sites. Most land disputes were settled locally.

By the late 1950s, population densities had increased. Makgotla headmen and their assistants began refusing to allocate new field sites for a variety of reasons some viewed as discriminatory. Under the Tribal Land Act of 1968, a single land board began operation in each of Botswana's administrative districts. By 1973, five subordinate land boards had been established in Kweneng. The six makgotla headmen and their numerous assistants who had managed the cultivation and grazing land near Letlhakeng were replaced by four members of the new subordinate land board for central Kweneng whose office was established in Letlhakeng. This board's jurisdiction covers an area of approximately 7,000 square kilometers. Its members manage four to five times as large a land area as had earlier authorities. The district land board is in practice a subordinate agency of the Ministry of Local Government and Lands. The minister can veto regulations issued by the district boards and is authorized to issue his own regulations to direct the work of all land boards.

In addition to the changes in the decision-making arrangements related to land allocation and adjudication, considerable changes have occurred in family structure. Wage labor opportunities for men have raised the value of men's labor relative to that of women's and contributed to a decline in polygyny. Social pressure to observe monogyny, accompanied by continued high fertility rates and male preference for younger wives, has produced a "surplus" of women. Some women now produce children but never marry. The divorce rate has also risen. As a result, male household heads today find themselves, for varying periods of time, responsible for several adult women who are not married to them. The productivity of these unmarried, divorced, or widowed women depends largely on the degree to which a male family head successfully integrates them into his production activity.

Patterns of Strategic Interaction

Adult male labor and draft oxen are the scarcest inputs in the cultivation process in the Letlhakeng region. Given this constraint, one would expect that cultivation land, which has been relatively abundant in the area, would be developed by low-resource agriculturalists, if they can, to economize on the use of the two scarcest inputs. A survey of the use-patterns in the area reveals an earlier pattern consistent with this hypothesis. Sons cleared fields for their wives near their mother's field so they could share one oxen team with their father. Sharing one oxen team enabled one adult male to plow a mother's field and those of several daughters and daughters-in-law, freeing all other adult males for wage-earning activity. This practice also minimized the number of male animals which needed to be sustained in a collective family herd.

Land allocation practices before the reform were well fitted to this way of organizing production. Use-rights were granted to blocks of land larger than the size of the single field initially developed. These larger blocks of land were allocated to heads of households in anticipation of the later development of additional fields for a second wife and for the wives of sons and grandsons. Buffers of land between blocks served as a grazing area for cattle kept near the fields in the growing season. Lower-income families grazed their smaller cattle herds on the periphery of the fields. Rights in land were retained even though the holder did not or was not able to cultivate a field for many years because of absence from the village, illness, or drought.

Under the Land Boards, land is allocated using relatively standard formulas unrelated to where land is held by other members of the same family. Cultivation plots are all about the same size with only sufficient space left between them for a roadway. Under the new directives, individuals may now have only one legally registered field. That field can be enlarged with authorized extensions without limit, provided the area is regularly cultivated. If no good reason can be given for a field remaining uncultivated for five years, rights to the field can be confiscated and regranted by the subordinate board. With some guidance from the district board, subordinate board members decide what constitutes a "good" reason.

Conflict over land has increased under the new land management authority. Land board members are told not to trust the information provided by makgotla leaders and established farmers because they will hoard land. Given the lack of any written recordation of past land allocations, "not trusting" the previous land authorities means that the Land Board members find themselves with access to little "disinterested" information about previous allocations of rights. Many villagers now consider land board members as incompetents who wittingly or unwittingly make trouble. Allocation of land under the new system makes it difficult to organize production so as to economize on the use of draft animals and adult male labor. Villagers do not like the new rules and they extended land board members little cooperation.

Proper allocation of land and adjudication of conflicts are dependent upon the members of the land board having access to different types of information such as those listed in Table 2. A land board member may have poor access to all of these types of information. Increased levels of public spending to assist board members in their decision making within the present land board structure could improve members' access to the first three types of information. Improved training programs and the attachment of legal

Table 2

Types of Information Needed by Subordinate Land Board to Allocate Common Land for Cultivation*

Type 1: Information regarding the provisions of the national constitution, relevant statutes, ministry regulations, and main land board guidelines regarding partitioning rules and the intent of these provisions.

Type 2: Information regarding the extent of subordinate land board discretion over the establishment and the application of partitioning rules.

Type 3: Information regarding the boundaries of use-rights in land established by previous land board decisions.

Type 4: Information regarding the character of land and water resources within their jurisdictions and how, in general, these resources are used as production inputs.

Type 5: Information regarding the boundaries of use-rights in land established by the earlier land administrators.

Type 6: Information regarding the preferences for partitioning rules of a community of farmers.

Type 7: Information regarding the value of use-rights to a particular field site to a given applicant.

*Original table in Wynne (1985).

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specialists to the boards could provide Type 1 and Type 2 information. The addition of technically trained surveyors and cartographers could improve the records of the board and provide Type 3 information. The selection of board members from among long-term residents of a given jurisdiction would help with Type 4 information. The Ministry has assumed that Type 5 information is available from the present *makgotla* headmen (without compensation for their time and effort) if only headmen and landboard members would respect and cooperate with one another. Given current patterns of interaction, this is unlikely. *Makgotla* headmen attempt to protect themselves and other *makgotla* members from new allocations, but they also attempt to avoid uncompensated effort and guilt by association with land board allocations over which they have no veto. The village development committees are expected to provide Type 6 information to subordinate board members but they have no formal authority. No weight is given to the importance of Type 7 information in the Ministry.

Outcomes

Drafters of the Tribal Land Act expected the decisions of members of the land boards to be more equitable than those of the earlier "traditional" resource managers and that they would enhance the efficiency of land use. Neither of these objectives has been achieved. Like the previous land authorities, land board members and their relatives are in a better position to protect their claims to land and obtain access to the land they want. They can better protect themselves and their relatives from illegal encroachment simply because they know the history of allocations related to their own and to relative's use. Their judgments in disputes not involving their own land must, however, be based on incomplete information. Under this system it is those villagers who are the most aggressive in placing their claims before the board repeatedly who are the most successful. Disproportionate awards on the basis of Land Board membership or pursuing aggressive strategies can hardly be said to have increased the equity of the system. Producer efficiency has also not been enhanced under the new system. Land board allocations using existing rules, regardless of whether they are based on accurate information about prior allocations or not, reduce producer efficiency of family production teams when they make it difficult to group the fields of female relatives. Given the particular labor and draft animal constraints on agriculture in this area, the location of a cultivation area is as important to many households as the absolute size of the holdings. In a situation that rewards aggression, individual land holders also incur greater time and effort costs in protecting their claims from encroachments and in securing land board judgments which establish their own claim. Individuals who cannot cultivate a contested field until a case has been settled lose the potential yield from that field.

Analysis of the Botswana Land Board Case

Compliance with this system has not been what had been hoped for. Farmers have cleared and plowed unauthorized fields, illegally extended the boundaries of their existing fields, and altered new boundary markers erected by land board members. Land board members have refused allocation requests in order to protect their own or relatives' interest. Frustrated villagers have threatened fellow villagers with physical violence. Recurrent conflict over rights to land leads to higher costs. More labor must be devoted to surveillance and negotiation to prevent incursion or the destruction of crops planted on contested plots. Conflict over land may also heighten tension in a community and reduce the possibility of collective agreement on other issues of common concern. Land may go unutilized despite high demand for the crops which a fertile soil could produce.

Still another important theme that needs to be discussed is the relationship of this reform to the development of citizenship capabilities. Botswana's political leadership generally encourages Botswana to take greater initiative in identifying and overcoming local problems through voluntary organizations. The Tribal Land Act, however, requires no direct citizen involvement in land management. The land board operating in central Kweneng has not encouraged groups of citizens to become involved in their decision making. The creation of the land board system is the last in a long line of important institutional changes that have reduced the number of arenas in which lekgotla members organized important joint undertakings. The pattern of response by central government leaders to problems of governance has been to remove authority from makgotla and villages and give it to authorities at the village, district, or national level. The considerable self-governing skills, which these people had developed in response to their isolation in the western desert areas of Botswana, have been shunted aside and are now only being put to use by small groups of farmers to organize ways of outmaneuvering the land board system. Possible long-term consequences include increased reliance on wage labor opportunities in South Africa and Botswana towns to the detriment of local expansion of agricultural activity by the poor and unconnected.

III. COMPARING AND EVALUATING THE OUTCOMES OF THE THREE CASES

A further way of illustrating the usefulness of the framework, now that the three separate cases have been presented, is to use the framework as a tool for overt comparison of the three cases and an evaluation of the outcomes. Let us examine how each of the three case authors used each of the conceptual elements of the framework in their analysis.

Attributes of the Good

Thomson - The windbreaks have attributes which simultaneously lead one to classify them as collective goods and as common-pool resources. It is difficult to exclude beneficiaries from either the windbreak effect or from the wood products. The benefit going to one farmer in increased productivity and reduced soil erosion does NOT subtract from the benefits going to other farmers, but if wood products are consumed by one farmer, this consumption subtracts from what is available to others. Effective use of the wood products depends on a high level of co-production of the management of the windbreaks.

Gellar - Millet is a private good (because exclusion is relatively easy to achieve and the good is not jointly consumed), but producers in Senegal have a low-responsiveness to changes in official prices because of strategies related to risk aversion and cultural-economic uses of millet not related to participation in external market structures. Measurement problems are also present because of the way diverse goods with different characteristics are aggregated together in national statistics.

Wynne - Cultural constraints mean that individuals cannot be excluded from rights to utilize land for cultivation, but consumptive use of land makes it a common-pool resource. Clear and secure divisibility reflecting effective family production strategies is essential, however, to utilize this common-pool resource efficiently. Otherwise, land is underutilized and/or transaction costs rise dramatically.

Windbreaks, millet, and agricultural land appear on the surface to be extremeley different types of goods. Without a framework to identify common attributes, it would be hard to know in what way they are similar and in what way they differ. Using two of the attributes of goods -- costs of exclusion and jointness of consumption -- the goods involved in these cases can be compared more readily as shown in Figure 5.

Figure 5

Goods Contained in Cases Compared on Two Attributes

	The Benefits from the Good are:	
The Costs to Exclude Beneficiaries from the Good are:	Separately Consumed	Jointly Consumed
Low	(Private Goods) Millet	(Toll Goods)
High	(Common-Pool Resources) Windbreaks as a source of wood products Common Land as a source of agricultural products	(Collective Goods) Windbreaks as a source of protection against soil erosion

All of the goods in these cases, except millet, share one attribute and the potential use of the windbreak to yield wood products and of land to yield agricultural products share both attributes.[1] Classifying the goods contained in these cases using two attributes helps us begin to identify in what ways are these goods similar and/or dissimilar. One would never presume that land and windbreaks (used as a source of wood products) are in anyway similar until one digs below the surface appearance and asks about the cultural, technological, and institutional foundations of how land and windbreaks are used in particular settings. In another setting, land

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[1] The high cost of exclusion related to land in Botswana stems largely from cultural norms. Land in many settings does not involve a high cost of exclusion and would be classified, with millet, as a private good.

and windbreaks might not share these same two attributes particularly in settings where one or the other (or both) have low costs of exclusion.

Operational Decision-Making Arrangements

Thomson - The basic structure of the DMA is a top-down hierarchical structure. Positions in this DMA are filled by forestry professionals whose careers in government depend upon doing a professionally defined task well and pleasing their superiors. Local valley residents have little information or preference aggregation input into the current DMA.

Gellar - Two DMAs are primarily involved in this case: (1) local markets for consumables and for credit which are primarily illegal and operate by participants bribing officials to look the other way and (2) family structures which assign differential responsibility to members of households affecting their capacity to respond to official or unofficial market signals. The official market, organized by the central government, is largely irrelevant.

Wynne - The basic structure of the DMA is a top-down hierarchical structure. The positions in this DMA are filled by local residents who are in no way responsible to those local residents. Local farmers have little information or preference aggregation input into the current DMA.

The DMAs in the Thomson and Wynne cases are quite similar in structure. The major difference is in the professional status of the foresters in Niger. The Nigerien DMA is matched to a complex good with diverse characteristics. One would expect this DMA to produce differential effects in regard to its being a collective good as contrasted to its being a CPR. That is what Thomas has found. Professionals in a top-down hierarchy may possess sufficient information to plan and carry out the construction and guarding of a windbreak, but they would face some of the same problems that their nonprofessional administrative colleagues in Botswana face if they were to try to allocate wood products without a major change in the DMA structure. The formal DNA in the Gellar case is also a top-down bureaucracy, but it is not the effective DMA in regard to decisions made by farmers about the production and marketing of millets.

Patterns of Interaction

Thomson - Little interaction occurs between the Nigerien foresters and the farmers in the Majjioa valley. Given the high investment made in guarding the windbreaks, farmers are rule abiding.

Gellar - Little interaction exists between central authorities and local peasants. Peasants are managing a complex, mixed system of subsistence agriculture, wage labor, investment strategies, and cash crops. Extensive interaction does occur in local commodity and credit markets where illegal trades are made in a predictable manner by locals who buy off government officials. Internal friction within families occurs over growing burdens on family heads. Strength of response to market signals varies across members of family and thus by region.

Wynne - Land board members are cut off from communication with and respect of villagers. Many farmers are dissatisfied with land board decisions. Conflict between the land board and villagers and among villagers is increasing. Necessary information is not available to the land boards.

Outcomes

Thomson - Public good aspect of windbreak is currently produced well, but benefits of common-pool resource aspect cannot be achieved under current system.

Gellar - Amount of millet produced has not increased in response to policy instruments of central government.

Wynne - Local residents have either not complied with land board allocations, have gradually reduced the amount of land cultivated by the women in a family reducing the amount of return available to the family, and/or have suffered higher transaction costs related to land use.

An Evaluation of the Outcomes

Let us now turn to an evaluation of the operational outcomes of these three cases using the evaluative criteria discussed above:

Short-Run Productivity Gains

The only case with evidence of any short-run productivity gains is in Niger where there is evidence of increased agricultural yield stemming from the windbreak. In Senegal, no evidence exists of increased productivity and in Botswana, there is some evidence of decreased productivity.

Long-Run Productivity Effects

While the long-run agricultural productivity effects in Niger will probably be positive, some long-term productivity may be foregone in relation to wood products unless new rules-in-use are developed for local windbreak management.

Efficiency

There is no evidence to support increased efficiency in any of the three cases. We do not know enough about the relative costs of inputs in Niger to evaluate if the enhanced productivity is sufficiently great to offset the costs of land taken for the windbreak, reduced numbers of grazing animals, and costs of personnel involved. Given the lack of productivity gains in Senegal and Botswana, one can only presume the efforts were inefficient since they involved higher input costs.

Fairness

The overt unhappiness of participants in the Botswana case about the fairness of the land board system provides relatively clear negative evidence in regard to this evaluative criteria in one of the cases. The other case authors are silent in regard to fairness.

Error Correcting Capacities

Given the lack of interaction between officials and low-resource agriculturalists and the little input that low-resource agriculturalists can make in regard to all three systems, none of them appear to have any sustained error correcting capacities.

Reproduceability of a Structure Over Time

So long as CARE or some other agency is willing to fund the guards and other personnel in the Niger case, it is relatively easy, if not relatively expensive, to reproduce. In both of the other two cases, many participants have strong incentives to try to pervert the formal systems. In Senegal, those incentives have already worked to make the formal DMAs almost entirely vacuous and thus not at all reproduceable over time. In Botswana, many participants are trying to go around the formal DMAs and take land rather than acquire land through the land boards. Thus, the process of subverting the structure is already far advanced.

IV. IMPLICATIONS

These three cases present a picture of the life of low-resource agriculturalists which is repeated time and time again in modern

Africa. The agriculturalists are engaged in a complex set of activities involving multiple crops, grazing activities, and employment as wage labor in various mixtures dependent upon the environmental and economic conditions of their local area. Life is relatively harsh. Family resource levels are sensitive to environmental conditions such as drought. Productivity in many regions has fallen because soils (which have already been severely eroded due to deforestation) have been overworked. In some cases, productivity has fallen due to reduced levels of cultivation. Economies which used to be self-sufficient in food are no longer so.

Development projects funded by external agencies have been most successful in constructing physical projects, such as roads and irrigation canals or the initial phases of windbreak construction. But all such projects run into grave difficulties when it comes to continued maintenance and productive involvement of participants. Central African governments and external donors have placed little emphasis or importance on the necessity of developing effective local institutions and have relatively systematically destroyed the local institutions which had existed earlier. Consequently, the interventions of central governmental authorities -- frequently paid for or demanded by donor agencies, such as AID, the World Bank, IMF, or CARE -- have either been successful only in the initial construction of public goods but not their long-term management and enhancement (as in the Nigerien case), ineffective (as in the Senegalese case), or counterproductive (as in the Botswana case).

Most African countries suffer from an excessive dose of centralization and reliance on a single type of institutional structure. During the past quarter of a century, many scholars studying the development process have presumed that centralized, hierarchical structures are necessary to achieve modern economic growth and stability (important exceptions are Korten, 1980; Uphoff, 1986; Esman and Uphoff, 1984; Bahl, et al., 1984; Bates, 1983; Leanard and Marshall, 1982; Popkin, 1981; Ruttan, 1984; Moris, 1984).. Many African public officials have been sent to the U.S., Britain, and France and received formal education that has characterized integration and centralization of political systems as desirable features while characterizing fragmentation and decentralization of political systems as pathological. Thus, systematic efforts havebbeen made to increase the use of hierarchy over the use of other types of institutional arrangements involving high levels of independence from the day-to-day direction of a central government.

Hierarchy is an important type of institutional arrangement that is well suited for many tasks. It is the optimal form of institutional arrangements for some activities. All institutional arrangements are subject, however, to limits. And, thus, there are limits to the effective use of hierarchy as there are limits to the effective use of various types of polycentric, decentralized arrangements which can be used both in the private realm (as various types of market structures) and in the public realm (as various forms of public service industries). Much of the work in development administrative has stressed the limits of polycentric arrangements in the private or public sphere and stressed only the presumed benefits to be achieved through centralized reliance on hierarchy.

Hierarchical designs tend to concentrate power in the hands of those individuals who have only highly aggregated and potentially distorted information about time and place specific events in a country. If central decisions are to be made about when seeds and fertilizers will be made available and what prices should be charged for all input factors and consumer goods, it is impossible to take into account all of the differences in local conditions over the time cycle of a single year, let alone longer periods of time. If effective, central directives of this type are always likely to be wrong for some local conditions. If ineffective, they add to the transaction costs of all involved, to the level of corruption in a system, and to a systematic distrust of the intentions and performance of central government officials.

Hierarchical institutional designs tend to eliminate redundancy from institutional arrangements. Given the fallibility of humans, however, failures are to be expected. Failure must not be thought of as occurring rarely and correctable simply by giving more training to people. The more fully interconnected are the actions of individuals, the more likely malfunction will occur somewhere in a system. "Redundancy is a means of keeping the system running in the presence of malfunction!" (Campbell, 1982: 73; see also Landau, 1985). When individuals at a local level have stable assignments of property and capacities to make key decisions affecting themselves and their neighbors, they can take local time and place information into account in making many day-to-day decisions.

The "ideal" decision-making arrangements for a modern African country will not concentrate all major decision-making authority at the local level. First of all, there is no "ideal" decision-making arrangement, only better or worse arrangements which have to be evolved and tried out within the cultural, economic, and environment context of a particular country. Secondly, over-reliance on any particular form of institutional arrangement is unlikely to produce a "better" fit to the problems that people are trying to solve (for a good proposal for a mixed system, see Thomson, Connerley, and Wunsch, 1986). We should not jump from the pan of over-centralization to the fire of over-deconcentration of power.

In a one-culture, one-production-process society, it would be possible to evolve one institutional arrangement over time which was well matched to the (nonchanging) cultural and material circumstances of that society. But most societies, particularly those of Africa, are characterized by cultural and technological diversity. Over-dependence on any one type of institutional arrangement -- whether that be a purely competitive market or a highly centralized state apparatus -- is bound to produce serious problems of institutional malfunction and/or failure.

Ecologists have come to recognize how various gene pools have adapted well to particular ecological niches and to appreciate the importance of maintaining genetic variety to allow for further adaptation over time to changing conditions. Social scientists and policy makers have been more enamored of the benefits of particular types of institutional arrangements and have tended to recommend one or two standard types for use in a wide variety of circumstances. We need to study how individuals, who have designed their own institutions through the ages, have tended to adopt a wide variety of institutional arrangements and understand why these work in particular ways when matched.

Engineers and physical scientists are certain to build redundancy into all physical control systems. The dominant theories of institutions used in development work have stressed the elimination of redundancy in the design of social control systems. Given this advice, it is not surprising to see the excessive levels of centralization which have resulted. Following this advice to build highly centralized political and economic systems may, however, have contributed to the extreme levels of institutional failure that has characterized much of the less-developed world. A different approach to institutional analysis is needed than that which has been applied during the past several decades if failure is not to reproduce failure in a continuing tragedy for the people living in these systems -- particularly the low-resource agriculturalists. The Institutional Analysis and Development approach discussed above provides the beginning of a coherent, cumulative approach to the analysis of problems facing low-resource agriculturalists in developing countries. The approach does not have an explicit or implicit preference for any single kind of institutional arrangement. The "preference" is rather for a variety of diversely scaled, nested, and differently organized institutional arrangements to enable low-resource agriculturalists and others in developing countries to achieve a more productive and less harsh and risky way of life.

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